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ECONOMIC

TRIPARTITE INDUSTRIAL COOPERATION BETWEEN EAST, WEST

Tokyo DIGEST OF JAPANESE INDUSTRY AND TECHNOLOGY in English No 164, 1981
pp 29-33

[Article by Teruji Suzuki, executive advisor, the Japan Association for Trade with the Soviet Union and Socialist Countries of Europe (SOTOBO)]

[Text]

General Trends of Tripartite of Industrial Cooperation

Ever since the beginning of East-West industrial cooperation, such activity has centered around large-scale plant exports from Western enterprises in a variety of fields. Rarely has this type of project involved third party countries in a tripartite relationship. The reason for this can be seen in both the belief that such activities are not economical and the fact that compared to the two major parties to such projects, there are many unknown and unpredictable areas concerning the capabilities of the third party country. Having to bear the risks entailed by these unknowns has created an unfavorable business climate for such relationships.

These tripartite relationships go beyond merely providing cooperation in the market of a third country (usually a developing country). They represent an inherent regional expansion of East-West economic cooperation.

If not viewed in this light, such tripartite projects would appear quite similar to the various multi-national projects presently being carried out by businesses of the advanced countries in developing countries, thus losing their uniqueness as tripartite projects. Normally, a tripartite cooperative project is said to be one in which a least three parties of differing nationalities and differing economic and technological levels join in international cooperation. While this type of project can be thought of as being a form of conventional international trade which centers around economic aid, the differing nature of third party markets in such East-West cooperative projects calls for new ideas and methodology in what could be thought of as a new international economic discipline. The new discipline has been accorded recognition to the degree that the term "tripartite industrial cooperation" has become an internationally recognized term, although a more accurate term in view of the East-West aspect of such projects would be "tripartite industrial cooperation between the East and the West."

Such East-West tripartite cooperation began in the form of bilateral relationships and entered a period of growth after the 1960s. Both economic and political factors were involved in this growth.

International trade and cooperation between the West and the East, wherein the Eastern nations possess only soft currencies, has continued in the form of peripheral economic activities outside of the framework of the *Bretton Woods System*. This is a distinct disadvantage, with Eastern countries forced to use either their small reserves of Western currencies or credit as a method of payment, resulting in a constant unfavorable trade balance for the Eastern nations. This problem of payments was forecast from the outset of this form of international trade.

While from an economic standpoint, the tripartite form of East-West cooperation has significance as a remedy for these problems, the political aspects must be considered as well.

Background of the Necessity

The fact that the countries of the East and the West sought partners for international cooperation outside of their own regions was a innovative international economic development and represents both an economic problem as well as an important political problem.

In a discussion of tripartite cooperation, the term third party country is used to indicate any of the many developing countries rather than a country outside of the region of the East and the West, as the term usually indicates. Unlike previous East-West cooperations, tripartite projects involving countries in this region require more than merely satisfying a set of economic conditions. They call for the consideration of political efforts required to fill the existing cultural and development level gaps. This political effort should strive on a government-to-government basis to eliminate to some degree the unknown elements encountered in such cooperative efforts, providing a stable business environment. In general, this is implemented by the working out of framework agreements by the governments of two or more nations. If this is not done, information concerning such industrial cooperation is not available to individual enterprises, resulting in an information gap. In such a situation, individual companies could engage potential buyers without realizing that they are taking risks which they cannot afford.

The Socialist countries used economic aid as a part of their foreign policy after the end of the Second World War, based on their ideology which supports self-determination and freedom from colonialism. Today, however, they are making the decision to provide economic aid based on practical economic considerations as well as the political climate in the target nation. In general, economic aid is based on an agreement between two nations to determine the details of the economic, scientific, and cultural cooperation. In addition to these aspects, details of soft aid such as loans and free technological aid are determined.

While the foreign policy approach of the Socialist countries to developing nations after the War was clearly one of a "protector", the international situation of developing nations today has become more complex.

Aiming at national and economic independence, the developing nations are faced with the necessity to engage in a pluralistic foreign policy. They already have the recognition that the Socialists are not their only benefactors and this is the difficulty of clear-cut understanding current North-South problems.

Tripartite cooperation is the meeting ground of the East-West and North-South problems, two issues which are usually discussed separately, and this is one of the unique features of this form of international cooperation. It is a form of cooperation in which political considerations must accompany economic considerations, so that governmental agreements become essential if this form of project is to succeed.

The term tripartite itself is imputed with a certain view of nations and their interrelations. If we consider the nations of the East and the West we see of course that both groups are in the group of Northern nations, and in contrast we can say that the third party partner would be referring to a nation in the Southern group, including nations in a very broad region encompassing Asia, Africa, and the Americas.

The selection of a trading partner in this region is not made on economic grounds alone. Since the nations of the East and the West have a stake in the nations of the South, cooperation with such nations as a third party partner must be based on a mutual agreement with coexistence as a prerequisite.

There is an added political significance to tripartite cooperation.

Since East-West tripartite cooperation develops mutually beneficial economic relationship, this must be accompanied by mutual political dependence. As long as there are political confrontations between the East and West, there is no reason for East-West industrial cooperation to develop.

The major gains that a third nation can make from tripartite cooperation is in funding and technology and it is nations which can gain in these areas that are prime candidates for such projects. This is the reason that the potential for such projects in North Africa and Asia is high.

Different Motives by Country

The countries which the Soviet Union and China select as partners in such economic aid projects are often chosen based on political considerations of those two nations.

On the other hand, the various forms of aid that former colonial or capital exporting nations such as United Kingdom and France and the U.S. have made available are designed to protect vested interests and their political presence in these countries. This is particularly true of the foreign policy with respect developing nations that evolved from what was the cold war.

However, as we entered the 1960s this two-dimensional confrontation of East and West over self-determination and anti-colonialism in the South became more complex, resulting in multilayered international relations with the North-South problem becoming more separated.

The first conference of UNCTAD (formed in 1964) which was attended by members from 77 nations of the South was a significant confrontation for both the West and the East nations who have taken in the past the position of protector of self-determination.

The multipolarization of the North-South problem resulted in a change in the general attitude of the Northern nations with respect to nations in the South. That is nations of both the East and the West came to modify their cold war type of foreign aid to give more consideration to geopolitical conditions as well as economic principles. Competition among the advanced nations for resources became particularly intense.

If the nations of the East and the West use geopolitical and economic conditions on which to base economic aid and cooperation, the area for coexistence and cooperation of the East and the West has potentially increased.

When we consider the complex conditions in developing nations, where constant local conflicts occur, we see both the possibilities and limitations of East-West cooperation in these nations.

The 1960s saw a split in the foreign policies of the Soviet Union and China. China began a more aggressive policy towards the developing countries of Africa.

However, in spite of the changes in China's policies towards the outside world, it is still geopolitically part of Asia in general and Southeast Asia in particular. People of Chinese origin have emmigrated to various countries of Southeast Asia, greatly influencing the economies of those countries. These overseas Chinese are an extremely significant factor in Asia.

Until 1970, China regarded the racial Chinese living outside of China's borders as part of the Chinese People, making an issue of this inside China as well as out. This must be thought of as an expression of the Chinese desire to place the overseas Chinese in Asia under the influence of the Chinese government.

This was a partial cause of the anti-Chinese violence that occured in Indonesia and Malaysia in the 1960s and a factor in the Chinese change in foreign policy with respect to Southeast Asia in the 1970s.

However, the economic power of the overseas Chinese remains as strong as ever. This overseas Chinese issue must, of course, be fully understood if East-West tripartite industrial cooperation is to work in Southeast Asia.

New Style International Cooperation

Thus tripartite industrial cooperation is a new, unknown form of international cooperation. It differs from the more conventional and easier to manage forms of trade, in that the parties involved in the relationships must, basically through their own efforts, strive to gain an understanding of the unknowns.

However, if basic trade-related conditions are not met, this form of cooperation tends not to succeed.

This is of course true for the case of Japan and other examples can be found easily in the nations surrounding Japan. The reason for this is clearly an information gap which does not allow risks to be predicted, resulting in the parties concerned making decisions based on conventional trade considerations.

The former colonial countries of Great Britain and France have developed uniquely friendly relationship to support their dealings with former colonial states. In answer to this, nations of the East have formed a number of friendly relations to formalize arrangements of economic aid with various developing nations. Cooperation agreements with third nations are often thus included not only economic aid but also scientific and cultural cooperations.

In addition, recent agreements between East and West powers have included agreements on the promotion of industrial cooperation with developing nations. This usually does not take the form of specific details but is left in terms of general principles, the internal laws of the individual nations bearing great importance.

In the case of the Socialist nations in particular, the position of international law dominant over domestic law is recognized as a principle of legal order, internal laws will give special consideration to such industrial cooperation stipulated by agreements.

In addition, although it is only a general rule, if grounds for mutual benefit are decided by government agreements, they form the basis of settlements of conflicts, should they arise. Thus, agreement between governments is an important part of tripartite industrial cooperation.

Future Direction of the Project

An East-West tripartite industrial cooperation project must deal with not only differing systems in the East and the West but also be able to cope with the cultural and economic development level differences encountered in the third country. From the standpoint of safety compared with conventional international trade, the number of governing factors multiplies.

One such area concerns differing cultures, where both the East and the West partners in the relationship have a European cultural background and the third party is a nation in a multi-cultural region. In these cases, it is extremely important to the success of the entire project that these many factors can be accommodated from within the enterprise itself.

While it is easy for a French company to provide industrial cooperation to a former French controlled nation, the same company would encounter difficulties in dealing with a former British holding. One wonders whether the Soviet Union or the Eastern European nations who have traditionally had little contact with the nations of Southeast Asia could understand and cope with the cultural differences in this area as well as such issues as that of overseas Chinese.

Tripartite industrial cooperation involving China, Africa or the Islamic nations must be able to deal with the overwhelming cultural problems posed by language, working customs, business practices and differing social value systems.

Thus, while tripartite industrial cooperation, a new discipline born of international economic dynamics, represents a mutually beneficial relationship which is presumably built upon rational considerations, the actual implementation of such relationships must work also in harmony with the non-economic elements of social and cultural target, lest the relationship be subject to a form of "cultural risk", which could be termed the cost of culture.

Historically, when directly faced with such multi-faceted cultures, for example, the Jews and Armenians in Europe and overseas Chinese in Asia especially, have handled the problem by specializing in transnational trade. While at present it is thought to be quite easy to deal with these problems for a nation possessing many national or racial groups, this cultural cost might multiply for a homogenious society such as Japan.

For conventional forms of trade, Japan developed a unique system of general trading companies as a means of conducting international trade. This, I believe, reflects fundamental economic and cultural isolation of Japan.

When dealing with third countries in industrial cooperation projects however, the level of contact with differing cultures increases greatly. There are cases in which the number of related companies in the target country reaches several hundred, and in which the number of international team members reaches several hundred to ten thousand. This, I feel, makes the cultural cost in such a project an important consideration. Whether this is to be considered as only a cost or a problem to be handled by the third country partners depends on the nature of the tripartite project.

How to Narrow the Gap

The East-West technocracy gap can be considered to be the result of East-West economic cooperation over the past 20 years. The Soviet Union, with the exception of its great military power, is behind the West, especially in the area of consumer technology. Technology transfer between the East and the West in general focussed on technology transfer from West to East. At times, this rapid transfer met strong opposition on both purely strategic grounds and as a part of a policy of economic watchfulness.

In spite of this transfer, the gap between the East and the West clearly continues to exist, particulary in consumer technology. The West had simply continued with more advanced technological developments while transferring relatively older technology to the East.

Therefore, as long as the mutual dependency exists between the East and the West, the East will remain in its position of an importer of technology from the West. In spite of the East's opening up of trade with the West, the past 20 years have continued to show a clear unfavorable trade balance.

While it is natural for the nations of the East to wish to export the fruits of their industrialization to world markets, in the present situation between the East and the West this desire is met with limited satisfaction.

If countries of the East and the West with clearly differing levels of technology can cooperate each in its own field, mutual benefit can be achieved. Tripartite industrial cooperation is the ideal vehicle for such a relationship.

This can be important on grounds of political benefit as well. That is, even if there is a limit to East-West economic cooperation, such cooperation can be achieved in spite of differing systems, the fundamental basis for the cold war itself. By virtue of continuing peaceful coexistence and detente, the limitations have clearly been lessened; particularly at the end of the 1970s. However, there is at times the possibility of change, as seen in the U.S. economic sanctions taken with regard to the Afganistan incident.

The North-South problem is one that the East and the West recognize as the same. In providing economic cooperation to the third countries of the South, I feel the maximum effort must be made to eliminate elements of East-West confrontation. That is, such cooperation should serve as a factor to maintain political peace. ■

CSO: 4120/74

SCIENCE AND TECHNOLOGY

STATUS OF OFFSHORE OIL, GAS EXPLORATION, DEVELOPMENT

Tokyo JAPAN PETROLEUM & ENERGY WEEKLY in English Vol 16, Nos 46-47, 16, 23 Nov 81
pp 10-18

[Text]

(This is the fifth in a series on Japanese oil exploration and development. - Editor)

Japan's offshore oil and gas exploration in 1981 witnessed the drilling of seven wells, including two wells presently under way. This is far below the target of 15 exploratory wells originally set in the Fifth Five-Year Plan for Domestic Oil & Gas Development formulated and published on July 26, 1979 by the Ministry of International Trade and Industry (MITI) (JPEW, July 30, 1979).

The distribution of these seven wells and the companies engaged in exploration activities are summarized below:

- Two wells have been drilled and one well is being drilled in the Japan Sea off Niigata Prefecture by New Japan Sea Exploration Co., a subsidiary of Idemitsu Kosan, and Amoco Japan Exploration Co. on a 50:50 basis. One of the two wells completed was sunk off Naoetsu under MITI's Five-Year Plan for carrying out stratigraphic drilling and hence was totally subsidized by the government, with New Japan Sea Exploration as the operator under a consignment contract with MITI. One well drilled off Aga North was successful, testing 4,000 b/d of oil production. An appraisal well is now being drilled in this field and two more appraisal wells are planned by March 1982. Details of the three wells are shown below:

  Off Aga North 1A-3 Well

. Location:	38°06'50"N 139°09'25"E
. Drilling period:	Spudded March 23, 1981; Ended April 23, 1981; Rig released June 8, 1981
. Well depth:	2,200 meters (7,216 ft)
. Water depth:	85 meters (279 ft)
. Rig used:	Hakuryu No.2, Japan Drilling Co.
. Results:	Successful

Off Naoetsu North Well

. Location: 37°23'28"N
138°10'46"E

. Drilling period: Spudded June 23, 1981; Ended September 16, 1981; Rig released September 26, 1981

. Well depth: 4,509 meters (14,790 ft)
. Water depth: 212 meters (695 ft)
. Rig used: Hakuryu No.5, Japan Drilling Co.
. Results: Dry

Off Aga North 1A-4 Well

. Location: 38°07'11"N
139°10'12"E

. Drilling: Spudded October 29, 1981, and is presently being drilled

. Well depth (target): 1,700 meters (5,576 ft)
. Water depth: 93 meters (305 ft)
. Rig being used: Hakuryu No.2

- One well was completed early in 1981 off Tomakomai, Hokkaido by Japex Hokkai Co., a subsidiary of Japan Petroleum Exploration Co. (Japex). This was the eighth exploratory well drilled in this area by the company, with one of them (Yufutsu B-2 well) confirming that the Yufutsu "B" structure has promising potential gas deposits. Details of the well are shown below:

Off Yufutsu B-4 Well

. Location: 42°27'55"N
141°46'09"E

. Drilling period: Spudded November 11, 1980; Ended January 19, 1981; Rig released February 26, 1981

. Well depth: 3,583 meters (11,752 ft)
. Water depth: 51 meters (167 ft)
. Rig used: Hakuryu No.2
. Results: Dry

- One well was completed around mid-1981 off Kashiwazaki, Niigata Prefecture by North Japan Continental Shelf Oil Co., a subsidiary of Teikoku Oil Co., as shown below:

Off Kita-Yoneyama-1 Well

. Location:	37°20'45"N 138°25'49"E
. Drilling period:	Spudded May 8, 1981; Ended June 13, 1981; Rig released June 19, 1981
. Well depth:	2,705 meters (8,872 ft)
. Water depth:	39 meters (128 ft)
. Rig used:	Hakuryu No.5
. Results:	Dry

- Stratigraphic drilling of one well has been completed early in 1981 off Miyako Island, Okinawa, under MITI's Five-Year Plan, with Teikoku Oil Co. as the operator.

Stratigraphic Drilling

. Location:	24°46'20"N 125°41'50"E
. Drilling period:	Spudded December 21, 1980; Ended February 20, 1981; Rig released March 6, 1981
. Well depth:	3,711 meters (12,172 ft)
. Water depth:	286 meters (938 ft)
. Rig used:	Hakuryu No.5

- One well is now being drilled in the subzone No.7 of the East China Sea continental shelf between Japan and ROK under the joint Japan-ROK oil and gas development agreement, with Hamilton Brothers as the exploration operator (and with Nippon Oil Exploration Co. as the exploitation operator), as shown below:

JDZ VII-2 Well (joint development subzone No.7)

. Location:	30°23'12"N 126°27'33"E
. Drilling:	Spudded October 5, 1981, and is presently being drilled
. Well depth (target):	4,200 meters (13,780 ft)
. Water depth:	80 meters (262 ft)
. Rig being used:	Hakuryu No.5

MITI launched its Fifth Five-Year Plan in April 1980 for exploration and development of oil and gas resources on the Japanese continental shelf and slope, with the government playing a leading role in extending financial assistance. Under the five-year plan, a total of 75 exploratory wells will be drilled during the fiscal 1980-1984 period with an estimated total expenditure of ¥160,360 million ($700 million) — with the government spending ¥29,770 million ($129 million) for reconnaissance surveys and stratigraphic drilling and the private sector spending ¥130,590 million ($568 million), which includes financial aid from the governmental Japan National Oil Corp. totaling ¥96,780 million ($421 million), for geophysical exploration and exploratory drilling. As a result of these stepped-up exploration activities, it is expected that Japan's offshore oil and gas production will reach 5.7 million kl (nearly 100 thousand barrels per day) in oil equivalent by 1985.

In addition to the above offshore activities, the five-year plan also envisages drilling of 50 onshore exploratory wells and capital expenditures totaling ¥36,540 million ($160 million), including ¥18,340 million ($80 million) of government funds, with oil and gas production expected to reach 2.3 million kl (40 thousand barrels per day) in oil equivalent by 1985.

Japan's continental shelf (with water depths up to 200 meters; 656 ft) is believed to have a sedimentary basin covering an area of about 150,000 sq km (37 million acres), while the continental slope (with water depths of 100-2,000 meters) is believed to have a sedimentary basin covering about 220,000 sq km (54 million acres). According to the latest revised estimates published in July 1979 by the Development Committee of the Petroleum Council, an advisory body to the Minister of MITI, the Japanese continental shelf/slope, at water depths of 500 meters (1,640 ft) or less, is estimated to have recoverable oil and gas reserves totaling 1.3 billion kl (8.2 billion barrels) in oil equivalent.

Japan's offshore exploration activities date back to 1958, when Japex started drilling offshore wells in the Japan Sea off Tsuchizaki, Akita Prefecture, using the rig "Hakuryu No.1" which is operable in water depths of 33 meters (108 ft) or less. By 1968, a total of 42 wells had been drilled off Akita and Niigata Prefectures, with a combined depth drilled totaling 77,997.7 meters (255,832 ft).

However, full-fledged offshore exploration was started in 1971, when Japex Offshore and Idemitsu/Amoco jointly began drilling exploratory wells off Akita, using the rig "Hakuryu No.2" (operable in water depths up to 200 meters), while Nishi Nihon Sekiyu Kaihatsu (a 50:50 joint venture of Shell and Mitsubishi-group companies which was later reorganized into the present Shin Nishi Nihon Sekiyu Kaihatsu) began exploratory operations off Shimane Prefecture, using the rig Ocean Prospector.

Shown below are the number of exploratory wells sunk on the Japanese continental shelf on a year-by-year basis. A total of 123 wells will have been drilled by the end of 1981, including two wells presently being drilled:

Calendar Year	Annual	Cumulative
Up to 1968	-	42
1969 & 1970	-	42
1971	4	46
1972	10	56
1973	11	67
1974	11	78
1975	4	82
1976	2	84
1977	8	92
1978	10	102
1979	6	108
1980	8	116
1981	7	123

Cumulative offshore exploration expenses during the period from fiscal 1971 through 1980 totaled ¥110,828 million ($482 million), while offshore development expenditures during the same period totaled ¥20,895 million ($91 million).

Japan's first substantial offshore oil and gas production began in September 1976 in the Aga Field, off Niigata, which had been jointly developed by Japex Offshore and Idemitsu/Amoco. The Aga Field's oil and gas production in fiscal 1980 averaged 1,140 b/d and 38.7 MMscfd, respectively.

As reported previously (JPEW, October 26 - p.10), preparations are now under way jointly by Teikoku Oil, Esso Sekiyu Kaihatsu and East Japan Oil Development, a Toa Nenryo Kogyo subsidiary, for commercial production of natural gas to begin in early 1984 at the Iwaki Field, in the Pacific Ocean off Fukushima Prefecture. The first gas field to be discovered on the Pacific side of the Japanese continental shelf, the Iwaki Gasfield is estimated to have total recoverable reserves of 3.5-5.5 billion cubic meters (120-190 billion cu ft). On May 19, the three companies signed an agreement with Tokyo Electric Power Co. to supply 1.2 million cubic meters per day (42 MMscfd) of gas and 40 kl/day (250 b/d) of condensate, over a 10-year period starting in February 1984, to a thermal power plant now under construction at Hirono, Fukushima Prefecture.

Shown below is Japan's domestic oil and gas production on a year-by-year basis during the past twelve years:

Crude oil/natural gas liquids production, 1,000 kl

	Onshore*				Offshore	
Fiscal Year	Japex	Teikoku Oil	Others	Subtotal	Japex Offshore/ Idemitsu/Amoco	Total
1969	335	478	75	888	-	888
1970	381	452	68	901	-	901
1971	392	413	62	867	-	867
1972	410	361	60	831	-	831
1973	408	348	62	818	-	818
1974	401	302	53	756	-	756
1975	366	277	56	699	-	699
1976	343	223	52	618	72	690
1977	301	205	44	550	122	672
1978	278	171	45	494	115	609
1979	264	155	41	460	91	551
1980	242	115	58	415	66	481
Cumulative	4,121	3,500	676	8,297	466	8,763

(*) Includes a small offshore production from 42 wells drilled in shallow waters during the fiscal 1958-1970 period.

Natural gas production, million cubic meters

	Onshore				Offshore	
Fiscal Year	Japex	Teikoku Oil	Others	Subtotal	Japex Offshore/ Idemitsu/Amoco	Total
1969	419	618	1,221	2,258	-	2,258
1970	509	639	1,240	2,388	-	2,388
1971	548	680	1,211	2,439	-	2,439
1972	613	748	1,151	2,512	-	2,512
1973	697	815	1,104	2,616	-	2,616
1974	732	743	1,031	2,506	-	2,506
1975	751	710	985	2,446	-	2,446
1976	713	630	972	2,315	289	2,604
1977	693	586	879	2,158	617	2,775
1978	636	477	914	2,027	556	2,583
1979	600	411	861	1,872	479	2,351
1980	588	380	784	1,752	399	2,151
Cumulative	7,499	7,437	12,353	27,289	2,340	29,629

(Source: Petroleum Producers Association of Japan)

Japex Offshore, Ltd./Idemitsu Oil Development Co./Amoco Japan Exploration Co.

Japan's full-fledged offshore oil and gas exploration and development activities started in July 1968, when a basic agreement was signed between Japan Petroleum Exploration Co. (Japex) and Idemitsu Kosan Co. to jointly undertake the exploration and development in the Japan Sea off Akita, Yamagata and Niigata Prefectures.

Consequently, the two companies established their respective subsidiaries — Japex Offshore, Ltd. (formed on May 20, 1971) and Idemitsu Exploration Co. (Japan Sea) (formed on January 26, 1971, and was renamed Idemitsu Oil Development Co., effective July 14, 1976) to promote the joint exploration/development project. Later, on June 7, 1971, Amoco Japan Exploration farmed in Idemitsu to acquire a 50% of Idemitsu's share in the project. Thus, the joint operation is now being carried out by Japex Offshore, Idemitsu Oil Development and Amoco on a 50:25:25 basis, with Japex Offshore as the operator.

On March 2, 1979, Idemitsu Oil Development established its subsidiary, Oga Oil Exploration Co., to promote exploration in an area off Kotokawa, Oga Peninsula, with Japex Offshore on a 50:50 basis. On March 3, 1980, Idemitsu Oil Development established its subsidiary, Niigata Oil Development Co., to promote exploration in an area off the mouth of the Shinano River, with Japex Offshore, Niigata Oil and Amoco sharing the working interest on a 50:25:25 basis.

A total of 16 exploratory wells were drilled under the joint operation program during the period from June 1971 through July 1980, as shown below. Oil and gas discovery was made in the Aga Field, which started commercial production on September 27, 1976, at the initial rate of 350 kl per day (2,200 b/d) of oil and 1.75 million cubic meters per day (62 MMscfd) of gas.

Company	Location	Drilling	Rig Released	Total Depth		Results	Rig Used
		Spudded/Ended		Meters	Feet		
Japex Offshore/Idemitsu Oil Development/Amoco (50:25:25)							
. Off Yuri North SI#1	139°56'15"E 39°40'44"N	June 14, 1971 Aug.31, 1971	Sept.6, 1971	4,015	13,169	Dry	Hakuryu #2
. Off Akita North SI#1	139°59'52"E 39°41'30"N	Sept.12, 1971 Oct.19, 1971	Oct.30, 1971	3,003	9,850	Dry	Hakuryu #2
. Off Aga SI#1a	139°07'24"E 38°02'18"N	Dec.10, 1971 Jan.22, 1972	Mar.2, 1972	3,505	11,496	Successful	Hakuryu #2
. Off Aga SI#2	139°08'22"E 38°03'34"N	Mar.5, 1972 June 25, 1972	July 21, 1972	4,574	15,003	Successful	Hakuryu #2
. Off Aga SI#3	139°05'57"E 38°02'57"N	July 23, 1972 Aug.20, 1972	Sept.9, 1972	3,511	11,516	Successful	Hakuryu #2
. Off Aga SI#4	139°06'53"E 38°02'21"N	Sept.11, 1972 Sept.24, 1972	Oct.8, 1972	2,400	7,872	Successful	Hakuryu #2
. Off Aga SI#6	139°06'07"E 38°04'01"N	Nov.15, 1972 Dec.8, 1972	Jan.8, 1973	2,400	7,872	Successful	Hakuryu #2
. Off Aga SI#5a	139°04'48"E 38°02'26"N	Jan.10, 1973 Feb.21, 1973	Mar.8, 1973	3,445	11,300	Successful	Hakuryu #2
. Off Yuri Central SI#1	139°56'27"E 39°36'32"N	Mar.15, 1973 Apr.11, 1973	May 3, 1973	2,771	9,089	Dry	Hakuryu #2
. Off Noshiro SI#1	139°49'13"E 40°09'02"N	May 6, 1973 June 7, 1973	June 14, 1973	2,360	7,741	Dry	Hakuryu #2

- Continued on next page -

		Drilling		Total Depth			
Company	Location	Spudded/Ended	Rig Released	Meters	Feet	Results	Rig Used
Japex Offshore/Idemitsu Oil Development/Amoco (50:25:25) (cont'd)							
. Off Shonai SI#1	139°48'32"E 39°06'58"N	Mar.28, 1974 Apr.17, 1974	Apr.30, 1974	2,004	6,573	Dry	Hakuryu #2
. Off Aga SI#7	139°07'25"E 38°05'33"N	May 5, 1974 May 19, 1974	June 2, 1974	2,300	7,544	Dry	Hakuryu #2
. Off Asanai SI#1	139°56'00"E 40°08'21"N	Sept.1, 1977 Sept.19, 1977	Sept.22, 1977	2,007	6,583	Dry	Hakuryu #4
. Off Kamaya SI#1	139°57'07"E 40°07'22"N	Sept.24, 1977 Oct.10, 1977	Oct.24, 1977	2,306	7,564	Dry	Hakuryu #4
Japex Offshore/Oga Oil Exploration (50:50)							
. Off Kotokawa SI#1	139°50'37"E 40°01'00"N	Feb.28, 1979 Mar.30, 1979	Apr.5, 1979	2,300	7,544	Dry	Hakuryu #4
Japex Offshore/Niigata Oil Development/Amoco (50:25:25)							
. Off Shinano River SI#1	139°02'55"E 38°00'53"N	Mar.30, 1980 July 27, 1980	Oct.6, 1980	5,315	17,433	Dry	Hakuryu #5

Japex Offshore, Ltd.

As referred to above, the company was established on May 20, 1971, as a subsidiary of Japan Petroleum Exploration Co. (Japex), to undertake the exploration and development off Akita, Yamagata and Niigata Prefectures, jointly with Idemitsu Oil Development and Amoco Japan Exploration, with Japex Offshore holding a 50% working interest in the joint project.

In addition to the operation outlined above, Japex Offshore presently holds equity shares in other Japanese exploration and development companies listed below:

(A) = Paid-up capitalization of companies, as of July 1, 1981, ¥million

(B) = Japex Offshore's capital investment in companies, as of July 1, 1981, ¥million

(C) = % Share of equity capital held by Japex Offshore, as of July 1, 1981

	(A)	(B)	(C)
Japex Sumatra Co., Ltd.	3,175	160	5.0
Japex Rantau Ltd.	684	37	5.5
Japan Oil Sands Co., Ltd.	3,641	60	1.6

Japex Offshore, Ltd. is now capitalized at ¥5,963 million ($25.9 million). Listed below are 15 shareholders of the company as of July 1, 1981:

	¥ Million	% Share
Japan National Oil Corp.	2,767.00	46.4
Japan Petroleum Exploration Co.	2,141.32	35.9
Mitsui & Co.	159.80	2.7

- Continued on next page -

	¥Million	%Share
Toyo Oil Development Corp.	159.80	2.7
Mitsubishi Gas Chemical Co.	111.86	1.9
Tohoku Electric Power Co.	111.86	1.9
Mitsubishi Petroleum Development Co.	92.3	1.6
Marubeni Corp.	91.3145	1.5
Sumitomo Corp.	79.9	1.3
Sumitomo Metal Industries, Ltd.	79.9	1.3
Nippon Yusen K.K.	68.4855	1.1
Teikoku Oil Co.	31.96	0.5
Mitsubishi Corp.	22.50	0.4
Mitsubishi Mining & Cement Co.	22.50	0.4
Mitsubishi Heavy Industries, Ltd.	22.50	0.4
	5,963.00	100.0

Idemitsu Oil Development Co.

The company was originally established on January 26, 1971, as Idemitsu Exploration Co. (Japan Sea) Ltd., a subsidiary of Idemitsu Kosan Co., to promote the exploration and development in a Japex-held area in the Japan Sea off Akita, Yamagata and Niigata Prefectures, jointly with Japex Offshore, Ltd. and Amoco Japan Exploration, with Idemitsu and Amoco holding a 25% working interest each in the joint project.

The company was renamed Idemitsu Oil Development Co. under the reorganization of the Idemitsu group of companies announced on July 14, 1976, so that Idemitsu Oil Development, as an oil exploration/development arm of Idemitsu Kosan, supervises all of Idemitsu group's oil exploration and development operations both at home and abroad, while carrying out the joint production of the Aga Field, off Niigata Prefecture, and further joint exploration with Japex Offshore, Ltd. as outlined above. The company is now capitalized at ¥6,466 million and is wholly owned by Idemitsu Kosan Co.

Idemitsu Oil Development Co's exploration activities in overseas areas are outlined below:

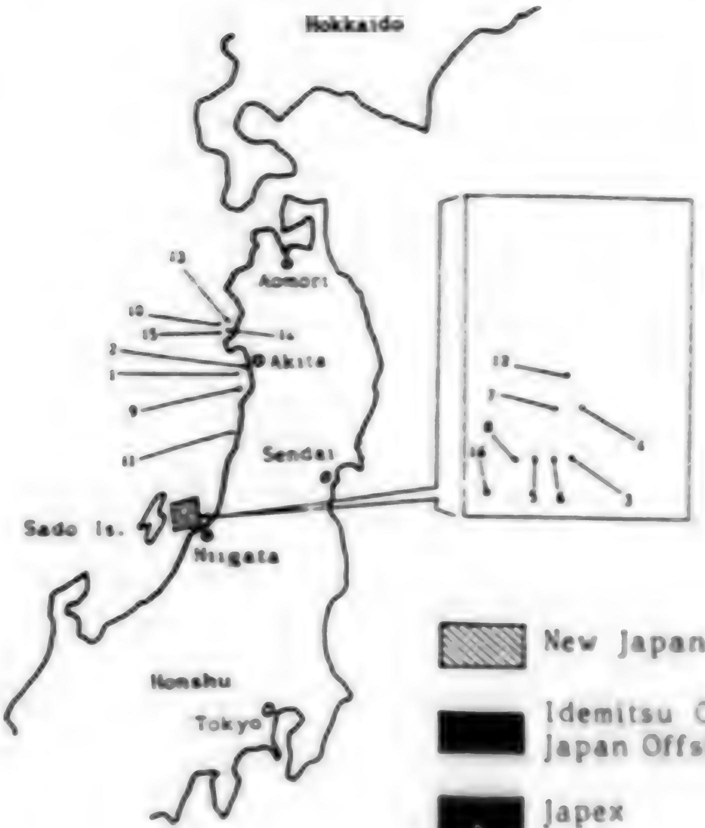
In August 1979, Idemitsu Oil participated in an offshore exploration program in the Gulf of Tongking in southern China, where 30 companies jointly conducted exploration of an area (26,600 sq km; 10,270 sq mi), with Amoco as the operator. In May 1980, Idemitsu Oil participated in an onshore exploration program in western Kalimantan, where eight companies are jointly conducting exploration, with Pertamina as the operator. Idemitsu South America Oil Exploration Co. was established in January 1981 as Idemitsu Oil's subsidiary, to promote exploration in Brazil, jointly with Elf, AGIP, and BP.

Idemitsu Oil Development Co's equity interests in its subsidiaries as of July 1, 1981, were as follows: a 59.9% interest in New Japan Sea Exploration Co. capitalized at ¥11,790 million; a 53% interest in Niigata Oil Development Co. capitalized at ¥660 million; a 53% interest in Oga Oil Exploration Co. capitalized at ¥180 million; a 79.1% interest in Idemitsu South America Oil Exploration Co. capitalized at ¥215 million.

- Continued next week -

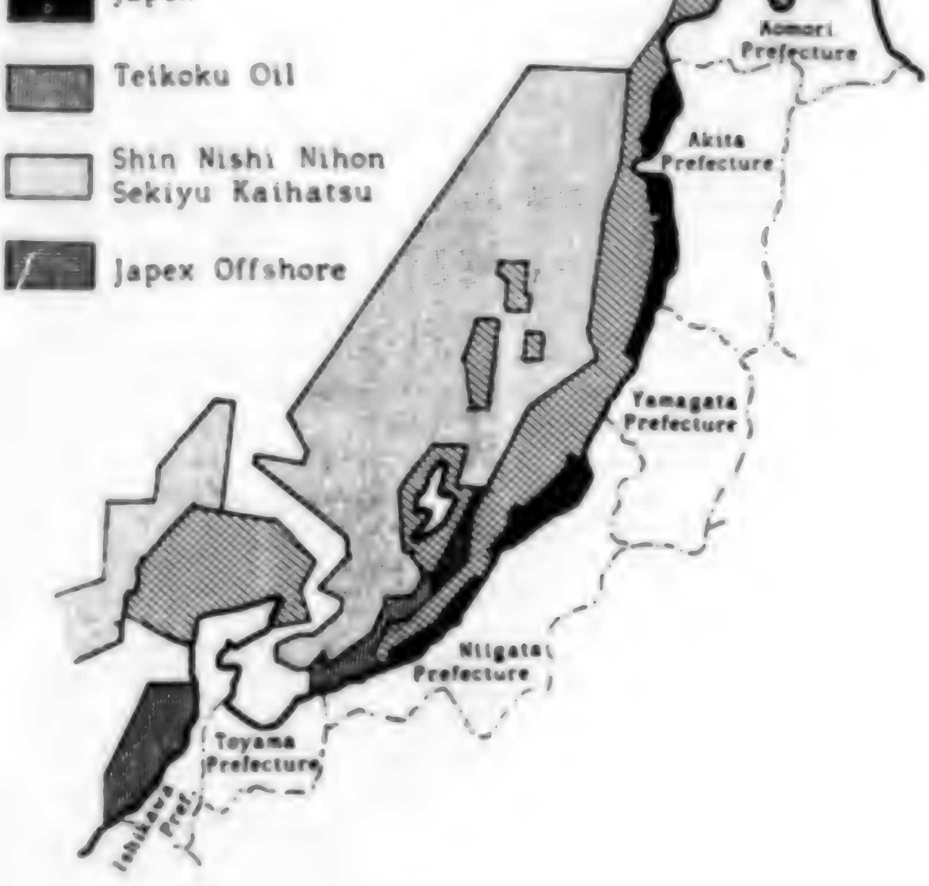
EXPLORATION IN THE JAPAN SEA

(Japex Offshore/Idemitsu/Amoco Joint Operation)



1 Off Yuri North SI#1
2 Off Akita North SI#1
3 Off Aga SI#1a
4 Off Aga SI#2
5 Off Aga SI#3
6 Off Aga SI#4
7 Off Aga SI#6
8 Off Aga SI#5a
9 Off Yuri Central SI#1
10 Off Noshiro SI#1
11 Off Shonai SI#1
12 Off Aga SI#7
13 Off Asanai SI#1
14 Off Kamaya SI#1
15 Off Kotokawa SI#1
16 Off Shinano River SI#1

▨ New Japan Sea Exploration
■ Idemitsu Oil Development/ Japan Offshore (joint operation)
■ Japex
▨ Teikoku Oil
□ Shin Nishi Nihon Sekiyu Kaihatsu
■ Japex Offshore



CSO: 4120/76

SCIENCE AND TECHNOLOGY

FINAL WORK UNDER WAY ON SELECTION OF Y-XX PARTNER

Tokyo JPE AVIATION REPORT-WEEKLY in English No 548, 25 Nov 81 pp 3-4

[Text]

The Japanese aircraft industry is going ahead with the final work on selection of a foreign partner in the development of the Y-XX 150-seat commercial transport aircraft.

Managing directors of three major airframe manufacturers--Mitsubishi Heavy Industries Ltd., Kawasaki Heavy Industries Ltd. and Fuji Heavy Industries Ltd.--left for the United States in mid-November to consult with leaders of the Boeing Co. and McDonnell Douglas Corp./Fokker group on details of their proposals for the Y-XX. At the same time, the Civil Transport Development Corp. sent a working-level mission to the USA to investigate future demand for 150-seat transport aircraft with visits to United Air Lines and Delta Air Lines, promising purchasers of such aircraft.

The consultations with candidates for the Y-XX partnership and the market survey will serve as the basis for the industry's decision on the selection expected by the end of this year.

Under the present circumstances, the industry is likely to select Boeing as the partner, provided that its terms for joint aircraft development with Japan turn out to be the same as those of the McDonnell Douglas/Fokker group and Airbus Industrie, another candidate, sources say. This is because the Japanese industry has been proceeding with the joint development and production of the Boeing 767 (Y-X) with the U.S. aerospace giant. Boeing has proposed the 7-7 as the Y-XX for joint development with Japan. But doubts are left about sharing of profits and other terms for the joint venture.

The three Japanese firms' managing directors were to confer with President R.W. Welch and Vice President J.F. Sutter of Boeing Commercial Airplane Co. on these questionable points. They will propose that Japan take part in all development, production and sales phases for the new aircraft with the participation ratio at 20 percent. Another task is to confirm whether Boeing will really go ahead with the 7-7 project.

The McDonnell Douglas/Fokker group's terms for the development of the MDF-100 as the Y-XX are said to be more favorable to the Japanese than the Boeing-proposed terms. The Japanese representatives are to confirm the overall picture for the MDF-100 project by talks with McDonnell Douglas Chairman James S. McDonnell and Fokker Chairman F. Swarttouw.

Airbus Industrie has proposed the A320-100/200 as Japan's Y-XX. The European consortium announced at the last Paris Air Show that it had already launched the development of the aircraft after receiving orders for 50 aircraft from Air France.

Prior to the final decision on the partner selection, the Japanese industry will consult with the Ministry of International Trade and Industry (MITI), which is to raise subsidies for the Y-XX project. The consultation will focus on what sections of the new aircraft Japan should develop and produce in the international program. The industry is inclined to choose the fuselage sections as it did with the Boeing 767 program, while MITI wants it to develop the main wing to expand its aircraft production capacity. MITI has sought ¥1,502 million for Y-XX project subsidies in its FY 1982 budget request.

Meanwhile, the industry briefed the ruling Liberal-Democratic Party on the Y-XX project on Nov. 10 to seek LDP support for the MITI-requested subsidies.

In this briefing, the industry said it intends to achieve great progress through the Y-XX program, which will be the last big commercial transport development program in the 20th century. It noted the aircraft will be a combination of sophisticated technologies, including composite materials and electronic controls, to feature fuel efficiency.

The industry also pointed out that any commercial aircarft development project demands much time and funding, and thus involves great risks. Since the Y-XX project is to coincide with the Japan-Boeing-Italy Boeing 767 (Y-X) production and the Japan/Rolls-Royce RJ500 (XJB) engine development programs, the Japanese aircraft industry would have to put up more than ¥350,000 million at peak phase, it said. Noting that aircraft development programs are supported by government subsidies in both Europe and the United States, MITI said it hopes that the LDP will give due consideration to government subsidies for the Y-XX program.

CSO: 4120/77

MATSUSHITA GIVEN ORDERS FOR B-767 AUDIO SYSTEMS

Tokyo JPE AVIATION REPORT-WEEKLY in English No 548, 25 Nov 81 p 5

[Text]

Matsushita Electric Industrial Co. has been awarded Boeing Co. orders for the MUX audio entertainment systems for the 300 Boeing 767s which the U.S. aerospace giant has begun to produce with Italian and Japanese aircraft manufacturers.

This is the first foreign order for the Matsushita MUX system, which is 30 percent lighter than other audio systems for commercial transport aircraft because of increased use of semiconductor chips. The system produces few malfunctions.

Boeing gave a high rating to the Matsushita system, and designated it for B-767s in February 1980. Matsushita delivered sample systems to Boeing in late 1980.

The systems are estimated to cost ¥50 to 60 million per aircraft. Matsushita has already started deliveries. But it will take several years to complete delivery of all the systems on order.

CSO: 4120/77

KHI SIGNS MEMOS WITH MHI, FHI ON MT-X

Tokyo JPE AVIATION REPORT-WEEKLY in English No 548, 25 Nov 81 pp 5-6

[Text]

Kawasaki Heavy Industries Ltd. (KHI), the prime contractor for development and production of the MT-X intermediate trainer for the Air Self-Defense Force (ASDF), has signed memorandums on the program with Mitsubishi Heavy Industries Ltd. (MHI) and Fuji Heavy Industries Ltd. (FHI) as subcontractors, confirming that priority will be given to their fixed contribution ratios, rather than to respective aircraft sections, for their manufacturing shares of the MT-X program.

The momorandums also provided that each subcontractor will be responsible for supplying and installing extra-airframe components for their respective sections. The contribution ratios will correspond to average labor expenditures for mass production, they said. The MT-X development program was started in late October with work on the basic design.

The fixed contribution ratios are about 38 percent for KHI as prime contractor, about 32 percent for MHI, and about 30 percent for FHI. KHI is expected to undertake fabrication of the front fuselage section and the horizontal tail, assembly of a full aircraft and flight tests. The sections for MHI to handle may be the middle and rear fuselage sections, the air inlet and the vertical tail. Those for FHI may be the main wing, the canopy, the head and the main landing gear door. The manufacturer distribution of the sections will be formalized after development of the design work.

Meanwhile, the JDA's Technical R&D Institute (TR&DI) has appointed Col. Tsutomu Kumagai as chief supervisor of the MT-X program and Yutaka Abe as deputy chief supervisor. It has also stationed five technical supervisors at KHI's Gifu Works where the basic design work is underway.

The ASDF will maintain the MT-X office at the Second Development Division and establish channels at the Air Proving Wing for the program.

CSO: 4120/77

JAPAN TO TRANSFER DEFENSE TECHNOLOGY TO U.S.

Tokyo JPE AVIATION REPORT-WEEKLY in English No 548, 25 Nov 81 pp 6-7

[Text]

The Japanese delegation at the third regular consultation with the Americans on defense equipment and technology, to be held in December or January, will declare that Japan can export defense technology to the United States irrespective of its arms export ban policy, according to Defense Agency sources.

This declaration will be Japan's final response to the United States' request for advanced Japanese defense technology which U.S. Defense Department officials submitted on the occasion of Japanese Defense Chief Joji Omura's U.S. visit last June.

The Japanese view of the declaration was jointly prepared on the basis of the Japan-U.S. Security Treaty by the Foreign Ministry, Defense Agency, and Ministry of International Trade and Industry following the U.S. request. The view also says that Japan can carry out joint research, development and production of military equipment with the United States.

At the coming consultation between defense officials of the two countries, the two sides will initiate discussions on specific items of technology for transfer to the United States, and also discuss joint research and development issues. Although the U.S. is said to have an interest in Japan's electronics and optics technology, an official request for specific items of technology is still pending.

The Defense Agency intends to start cooperation with the United States in defense technology with an exchange of visits by military engineers.

CSO: 4120/77

JDA ORDERS THIRD AIS FOR F-15

Tokyo JPE AVIATION REPORT-WEEKLY in English No 548, 25 Nov 81 p 7

[Text]

The Central Procurement Office of the JDA has concluded a ¥6,624 million contract with C. Itoh Aviation to purchase the third Bendix avionics intermediate shop (AIS) for the F-15J fighter aircraft for the Air Self-Defense Force (ASDF) with delivery scheduled for October 1983.

The third AIS will be installed at Hyakuri ASDF Base. The first was ordered in FY 1979 for Nyutabaru Base and the second in FY 1980 for Chitose Base.

The first AIS, consisting of six stations, is now being installed at Nyutabaru Base for operational tests of the F-15 starting in January 1982. Its three stations have been tested by Mitsubishi Heavy Industries Ltd. which is undertaking production of F-15s under license by McDonnell Douglas Corp. The second system will be delivered between July and September 1982.

The three AIS systems will be used for the authorized 100 F-15s. If the JDA decides to procure more F-15s, however, additional AIS purchases would be considered.

CSO: 4120/77

SCIENCE AND TECHNOLOGY

ASDF MAY LAUNCH FS-X DEVELOPMENT IN FY 83

Tokyo JPE AVIATION REPORT-WEEKLY in English No 548, 25 Nov 81 pp 7-8

[Text]

The ASDF may start on development of the new FS-X support fighter aircraft as a replacement for the current Mitsubishi F-1 in FY 1983 to contend with F-1 retirements starting around 1990.

If F-4EJ fighter-interceptors are used to replace the retiring F-1s, however, the development launch could be delayed until FY 1987.

The ASDF is now considering the FS-X development project as part of a new medium-term defense program (MTDP) covering FY 1983-87. It has tentatively decided to procure about 70 F-1s for three 18-plane squadrons and reserves, although its original plan had envisaged 100 planes for three 25-plane squadrons and reserves. After purchasing 64 aircraft between FY 1975 and 1979, two to three aircraft have been ordered annually. This pace will continue till around FY 1985, when the ASDF will stop purchasing F-1s.

The service intends to establish three 25-plane support fighter squadrons under the FY 1983-87 MTDP as originally planned. In that case, it would have to make up for a gap of about 30 aircraft between the current 70-plane setup and planned 100-plane setup by the final year of the new MTDP. Additional purchases would also be necessary as replacements for aging F-1s. The ASDF is conducting studies on whether or not it should develop a new support fighter, or else use the F-4EJ to fill the gap and prepare replacements for obsolete F-1s.

CSO: 4120/77

ASDF PLANS DEVELOPMENT OF NEW RADAR IN FY 1983-1987

Tokyo JPE AVIATION REPORT-WEEKLY in English No 548, 25 Nov 81 p 8

[Text]

The ASDF hopes that the TR&DI will launch a five-year program in FY 1983 to develop a new three-dimensional warning/control radar system for air defense, according to informed sources.

The service may set requirements for the radar system for submission to the TR&DI in March 1982. If the TR&DI agrees to incorporate the program into a budget request for FY 1983, the ASDF would request proposals for the radar project from contractor condidates in April, and choose a contractor around June. The contractor candidates include Toshiba Corp., Nippon Electric Co. and Mitsubishi Electric Corp.

The ASDF intends to install the new radar systems at eight of its 28 radar sites throughout Japan starting in FY 1990. The eight sites are now equipped with FPS-20 search radar and FPS-6 height finder radar systems supplied by the U.S. Air Force.

The remaining 20 radar sites are being equipped with the J/FPS-1 (F3D) or J/FPS-2 (modified F3D) fixed three-dimensional radar developed by the TR&DI.

The new radar system will be superior to the J/FPS-1 and J/FPS-2, with electronic counter countermeasures (ECCM) and improved durability. The ASDF plans to operate all three types of warning/control radar systems in future.

CSO: 4120/77

RESEARCH, DEVELOPMENT IN KEY MISSILE PARTS TO BE PROMOTED

Tokyo JPE AVIATION REPORT-WEEKLY in English No 548, 25 Nov 81 pp 8-9

[Text]

The TR&DI plans to fabricate electronic scanning antennas and rocket engines using the CDB (composite double base) propellant in FY 1982, starting in April 1982, to prepare for development and improvement of missiles in future. Research and development of such key missile components have been rated most effective worldwide.

The electronic scanning antenna is expected to be useful for reducing the size and weight and improving the reliability of various missiles, while the CDB propellant rocket engine is likely to increase overall missile performance.

The TR&DI has continuously developed various propellants for such missiles as the ASM-1 air-launched anti-ship, the SAM-1 short-range surface-to-air and the Model 79 MAT antitank models in cooperation with Daikin Kogyo Co., Daisel Ltd. and Asahi Chemical Co.

It developed a new solid propellant between FY 1963 and 1966, a high-performance rocket engine propellant from FY 1967, and a high acceleration rocket engine, as well as HAP and NP propellants from FY 1972. After FY 1975, it fabricated smokeless, high-thrust HTPB (hydroxyl terminal polybutadiene), MHD composite, RDX/AP composite, HMS-CMDB and other propellants. The CDB and other new propellants are expected to be developed for the planned XAAM-1 air-to-air and XATM-3 antitank missiles.

CSO: 4120/77

PREDEVELOPMENT TESTS UNDER WAY FOR NEW TANK

Tokyo JPE AVIATION REPORT-WEEKLY in English No 548, 25 Nov 81 pp 9-10

[Text]

The TR&DI has been conducting technical tests prior to engineering development of a new main battle tank (MBT) for the Ground Self-Defense Force (GSDF) starting in FY 1982 (April 1982-March 1983).

Since last May, it has carried out firing tests to confirm the performance of the 120mm smooth-bore gun and APDSFS and APDSMP projectiles. Tests in November were aimed at evaluating hit accuracy with the fire control system (FCS) used. Firing tests aboard a running vehicle will take place soon.

Technical research on the new MBT started in FY 1974 when the sophisticated Model 74 MBT entered service. The TR&DI had fabricated an FCS, hydraulic motor, 120mm smooth-bore gun, APDSFS and HEATMP projectiles, engine space, armor structure, chassis and other components by FY 1980 for system study in the current fiscal year. A ¥92.49 million contract for a system study to span the past technical research and the coming engineering development has been awarded to MHI.

The GSDF and TR&DI have earmarked ¥7,000 million for launching the engineering development in the FY 1982 budget request. They plan to develop the new MBT by FY 1988.

CSO: 4120/77

FUTURE COURSE OF MACHINE TOOL INDUSTRY

Tokyo DIGEST OF JAPANESE INDUSTRY AND TECHNOLOGY in English No 164, 1981 pp 5-9

[Article by Yoshitaro Yoshida, director of Machine Tool Division, Machinery Department, Mechanical Engineering Lab., Agency of Industrial Science & Technology, MITI]

[Text] Machine tools have been improved greatly as a result of numerical control technology, making them easier to use. They show up in many different forms using systems and electronic technology. Let's examine Japan's machine tool technology from this standpoint, because it's expected that this trend will continue

Flexible Manufacturing Systems

Machining systems that are being used efficiently for many types of medium and lightweight machining are called flexible manufacturing systems (FMS). These systems were the result of numerical control technology, electronics, and machining tool technology. These systems have been invented due to increasing wages for labor, shortages in skilled machinists, and the lack of young workers with ability. Complete automation of machining systems is unavoidable necessity.

The necessary development of DNC systems, machining centers as system machines (Figure 1), and flexible machining systems with conveyor systems employing improved conveying equipment, has already been sufficiently carried out. There are already a number of these systems in operation. There are not only machining centers, but a variety of machines that are system machines with loading to a built-in NC lathe. With these system machines, flexible machining has been made possible. The FMS from Toshiba Tungaloy company is made up of a machining center, NC lathe, and grinding machine (Figure 2).

Simple combinations of machining centers is not the only development. It will probably become important for NC machine tool combinations to have a number of functions. In the future of automatic machining, machining tools must be able to pick up and remove the part being machined and be able to place them on or remove them from conveying systems. Robots are always available for this task, but from the standpoint of cost and amount of space taken up, it will be necessary to have robotics built in.

FMS are limited in their cutting and grinding ability, but it will be necessary to consider the assembly and inspection processes for production systems. Complete FMS systems will be demanded in the future. Assembly processes must especially be made simple and rational if they involve manual operations. For that purpose, we will have to have complex machining systems—FMC. This way of thinking must be further developed so that the assembly process will become more efficient. The active use of multi-purpose robotics is also important. It will be necessary to respond with combinations of robots as

Mechanical Engineering Laboratory

This laboratory conducts basic research for contributing to the mechanical industry, as well as research and development of new technologies. In specific terms, its research work covers systems engineering, heat and fluid technology, automatic control, safety engineering, antipollution technology, production engineering and many other fields.

For future-oriented problems, the laboratory is conducting studies on biomechanics, computerized production technology, technology to meet energy requirements, and the possibility integrating all such fields.

simple as possible. We will have to replan the division of work of machining, assembly, and processing. On the other hand, machining will have to be as accurate as possible. It will be necessary to have automatic designing of the part's shape so that it can be easily assembled.

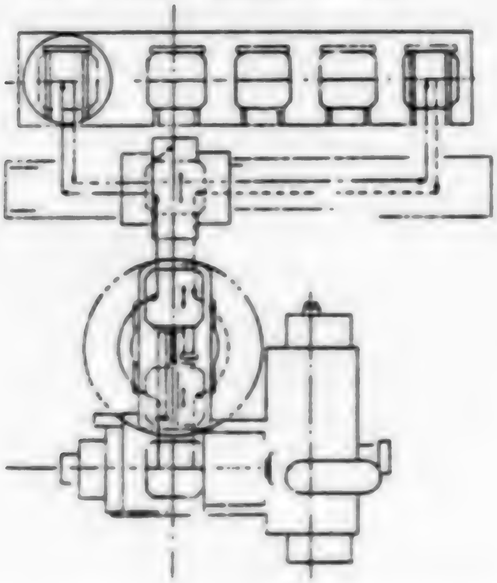
Electronics Allows for Automation

Electronics must be used to achieve the goal of complete automation. It will be applied in examination and diagnosis technology. Electronics is the most appropriate method for measuring and generating information for everything from simple dimensional measurements, to investigations necessitating human response, diagnosis of machining tools, pattern recognition techniques to replace the human eye, and different types of sensor technology.

Electronics and opto-electronics are best for deciphering information, newly generating command information, and for transmitting different information. In this manner, information generation, processing, and transmission will be widely performed with the development of microprocessors and miniaturization.

The main problems will then be: Which information to select, and how to process it to improve the SN ratio and input it. What will have to be done to the actuators changing output information as the machine progresses in its work to get better output.

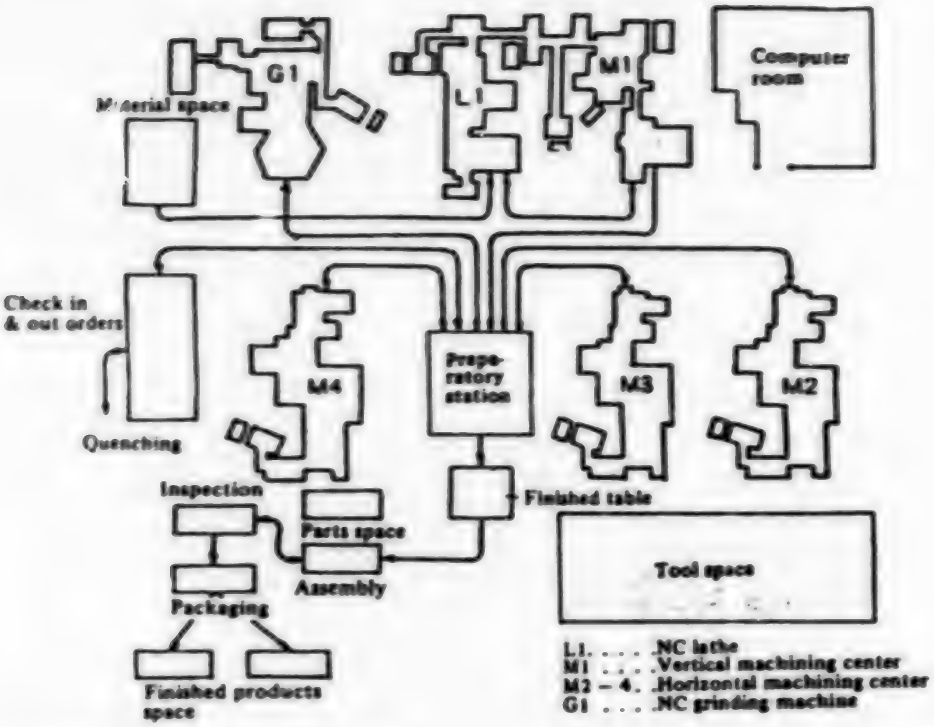
Fig. 1. Truck-Type Pallet Pool Line



New Capabilities Accompanying Electronization

It can be safely said that the information input/output section of machine tools has changed with the development of microprocessors. Other changes are the mini-

Fig. 2. Flow Chart of FMS in Toshiba Tungaloy Co.



aturization of NC equipment, high-speed processing, greater memory capacity, and expansion of the capabilities of the robotics. Input information has become more abundant with the miniaturization of sensors. It will be necessary for the machine tool's hardware also to be improved to more efficiently use this information. There has been a reduction in the number of gear-changing parts. Now we have DC motors that permit work on the main spindle without stepping. Ball screws were also developed to facilitate the transmission of commands from NC equipment. We have also seen changes in the driving systems, advancing from DC servo-motors to AC servo-motors.

In the future we will need to have sufficient torque at low speeds and good control of the driving systems at high speeds. We will be able to make the machines look smarter by inter-cooperative manufacturing with peripheral equipment. AC systems are examples of those that have been made smarter by using microprocessors in peripheral equipment. Electronics or microprocessors using sensors have been developed for the apparatus that can adjust to allow for the most appropriate cutting conditions.

These include controlling the cutting power or feed and cutting. The best signal system for controlling is the feedback system which controls after the cutting power changes. It will become necessary to have a feed-forward system that controls by forecasting changes. The problem will then be development of sensing techniques to forecast changes for that. One of those is the development of sensors which can investigate the workpiece not as a touch-sensor, but as a sensor able to sense it before touching it. This will become important in the future as more expensive workpieces and tools are used. It will be useful for improving the operation rates of the cutting machinery or for protecting the tools and workpieces.

There are many problems remaining that must be thought about, such as the combination of meters and machine tools. Efficient operation of microprocessors is awaiting on-machine, on-line meters with the capability of not only feedback control based on the dimensions of the workpieces, but also based on the surface shape and roughness of the workpiece and use of laser holography. We must also think about the new developments peripherals for machining tools.

NC Software (CAD/CAM)

We must first consider NC programing when talking about NC software. The first automatic programing system, APT, didn't stop with simply commands for movement of the tool, but went as far as permitting automatic designing of the processing. The establishment of machining conditions in EXAPT must naturally be included in the discussion of automatic program processing. For that reason, data collection of machining technology has become important. NC software is not merely programing the machine tool's path. It must also incorporate all of the information needed for creating a final product.

This generates many demands for program flexibility and for use in production administration. These demands include not only the shape description of the parts by software but also software for process planning: systems to automatically establish machining conditions and parameters for setting up machinery. This field of research has just been started and great hope is being held out for it. There is considerable demand for CAD/CAM total systems.

We can't forget to talk about data bases. The organization of data bases becomes very important with the development of systems and the abundance of system's contents. What kind of data base to prepare? Will the data base be unified? What applications will be made of the data base? These are all questions of software. Problems like these will increasingly become important: They must be researched so as to further progress.

New Machining Technology

It appears as though we are making rapid progress in getting machining data to set up data bases. Unless data base maintenance is made easier, we will not be able to put into using the modern technical information we are now developing.

This is the age of common construction steel and cast iron machining. With improvements in materials, we are seeing the entry of new materials for different tasks. In the same way, different tool materials have been developed and machining conditions have been altered. Of course, changes in machining apparatuses can also be seen. Cutting machine technology is responding it the task of cutting difficult materials with such technology as electro-chemical processing. The wire-cut machining tool is one example. Because the accuracy of the wire-cut machining has been improved, it is excellent at machining molds and is particularly good at trimming dies. With advancements in tool materials and improvements in machining technology, it has now become possible to work materials which have previously been too difficult. The result of improved machining accuracy allows for easier interaction with the grinding process. As hand-finishing techniques are being lost in our generation, this area too must be given proper consideration.

The development of new machining types using diamonds and CBN tools will require machining techniques which are better and with more capability. Will our current modern machining tools, in particular NC machining tools, be able to respond sufficiently to those demands? Machining tool designers and process engineers will have to put a lot of thought into this.

Construction Design and Machining Techniques

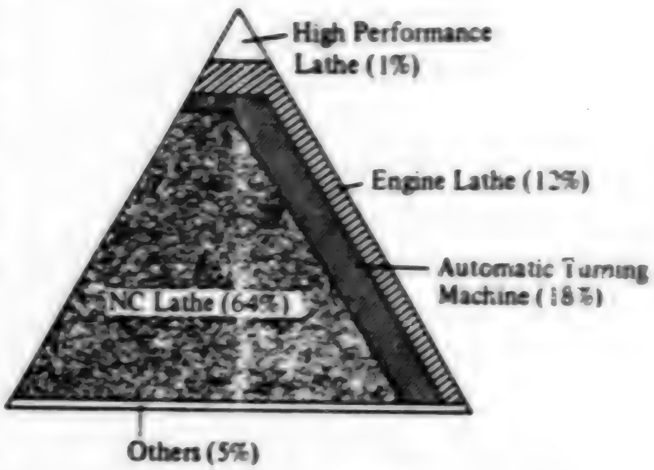
Let's think about how machining tools should be constructed. Take NC lathes as an example. They have, in general, become better and they are easier for the operator to operate due to electronics. One NC lathe is able to have six to eight tools and can shape a wide variety of designs in one turn of the lathe. Demand for lathes, which are easier to use and with greater rigidity, is due for the most part to the successive development of materials that are harder to machine. Accurate machining tools that have high rigidity have been requested with the idea of shortening the grinding process based on grinding a workpiece after heating. Of course, grinding machines in the future will have to be more accurate.

The next generation of materials to be used by future leading industries will include materials that are especially hard to work. Even the automobile industry of today is using hard-to-work materials such as super-high tensile steel. For that reason, there must be an overall improvement in the rigidity of machining tools and at the same time, ample consideration must be given to workpiece/machining tool, tool/machining interfaces.

As machining tools become rigider, parts such as the fixtures holding the workpieces (example: a chuck), and holding the tool (example: a tool-rest or collet), will have a greater relationship to machining capability. Only when tools and workpieces having sufficient rigidity are incorporated in machining tools, will the true capability of tools and tooling machines be forthcoming. This will depend on ways to attach the tools and workpieces that accompany the main spindle–making them more rigid; making it so that there will not be any vibration in the attachments during heavy grinding throughout the fixed lifetime of the tool. Full play cannot be given to tools or machining capabilities if either the tool or the workpiece is weak. Thus, careful thought must be given to the design of the relationships between tools, machine, and the workpieces. It will especially be necessary to further research the forces giving rise to vibration that occur between the tool and workpiece.

We must also gather data about machining that borders on other fields such as, ultra-precision machining, high-speed cutting, and high-temperature cutting. At the same time, we must carry out more research on the machining tools themselves (including peripheral equipment). In this case, it will be necessary to advance research by cooperating with certain fields having to do with meters that will be used on-line during machining, and on the machine. Because the problem of surface changes in quality, strata are included within these problems, so we must further study such points as machining conditions and the strata of machining quality changes, strata and parts accuracy, and durability.

Fig. 3 Lathe Production



Future Tasks

We have listed a number of the problems that must be considered as we approach the year 2000. In this section, we would like to mention some other problems as well.

We must research: High-speed cutting, based on new tools, for mechanical machining techniques; ultra-precision machining equipment and machines that can work on new materials; new machining techniques for specialty materials; and high-capability cutting techniques. For machines like these, it will be necessary to have advanced mechanical technology. Figure 3 shows, from a financial point of view, the manufacturing rate of lathes. NC lathes are still in the development stage but their main feature is ease of use. Although there are engine lathes which have high capabilities (strong cutting and high precision), I think that there are very few with such capability. It is necessary for Japan, in our pursuit of becoming a technical-based nation, to develop machining tools that we will be proud of, which other nations will seek to imitate. It will be necessary to have an accumulation of not only electromechanics but also basic mechanical technology.

It will be necessary to introduce electronics technology for the efficient use of systems technology. It will have to be electronic technology of investigative diagnosis and on-line metering techniques. It must even include so-called machining intelligence. It will be necessary for the cooperation of various fields – applied physics, applied chemistry, and electronics–to make the machines more intelligent. We must re-examine the basics of machining and not research the problem from just the electrical standpoint. In the future development of machining, we must think about the harmonious cooperation among various fields. The essence of mechanical machining techniques–the essence of machining tools–is basic technology that is steadily developing mechanical technology. Unless this field is developed, the future progress of machining tooling will be slow. We must make up our minds to take a new and more innovative look at mechanical technology. ■

CSO: 4120/74

SCIENCE AND TECHNOLOGY

CURRENT TRENDS OF MACHINE TOOL INDUSTRY

Tokyo DIGEST OF JAPANESE INDUSTRY AND TECHNOLOGY in English No 164, 1981 pp 11-15

[Article by Shinshichi Abe, managing director, Japan Machine Tool Builders' Association (JMTBA)]

[Text]

Seeking Further Promotion of Orderly Marketing Activities

Machine tools have assumed a strong character of classification as an international product. Since the export ratio of Japanese machine tools have maintained a 40 percent level despite expansion of the production scale, we should become aware of the fact that the machine tool industry should be fully considered from the international viewpoint instead of only the domestic point of view.

The following is a general view of the recent business trend from the machine tool industry side.

[illegible]

A 1980 tabulation of the volume of orders of 68 leading companies belonging to the Japan Machine Tool Builders' Association (JMTBA) amounted to 621.5 billion yen (currently about 230 yen level to the dollar) which is a 42 percent increase over the preceding year. It is estimated that the figure will reach 820 billion yen when calculated on a national basis. It is noteworthy that the each total of both the 68 companies and the national basis were the highest to date indicating an increasing trend on a continuing basis.

A look at the 1980 ratio of machine tools by demand (user industry) showed that general machinery occupied 29 percent followed by automobiles with 27 percent and exports 26 percent. These three demand sectors occupied 82 percent of the total.

In reviewing the principal sectors which were the key factors in the growth of demand, the contribution ratio of automobiles was 53 percent in 1976, the export contribution ratio was 52 percent in 1977, the general machinery ratio 52 percent in 1978, the automobile, export and general machinery ratios were all high in 1979 and the automobile contribution ratio was 40 percent in 1980. In this manner, these three sectors assumed the role of an engine for the past several years. It could be said that this general trend will continue for some time.

The reasons for this machine tool development are a further strengthening of depreciation demands in industrial circles since the first oil shock, the carrying out of brisk activities toward diversity and model change in order to stimulate demand and matching demand by improving quality and producing compact precision tools. Other reasons are the introduction of labor-saving and unmanned machines to cope with a lack of skilled workers and the aging of workers in industrial circles, brisk plant investments due to changes in the international investment environment, the renewal of plants built during the high growth period and the expansion of overseas markets on a global scale.

In reviewing the developments mentioned earlier, the volume of orders remaining as of March 1981 amounted to 318 billion yen on the basis of 68 member companies of JMTBA. The figure represented a 21 percent increase over the same month of the preceding year or about a six-month volume of orders.

However, the high machine tool order trend has tapered off markedly from the beginning of 1981 as indicated by the 16 percent increase in January over the previous year, a seven percent increase in February and no increases from March to May. The growth rate from January to March showed an increase of only seven percent over the preceding year. Attention is focusing on future trends because the growth reduction has been noted in all fields including overseas demand, automobiles and general machines.

Production

The trend of advance-orders is as mentioned earlier but a look at the actual production situation on the basis of 'dynamic statistics' compiled by the Ministry of International Trade and Industry in 1980 showed that the output amounted to 682.1 billion yen. The figure represented a 41 percent increase over the preceding year.

The production total amounted to 228.6 billion yen during the bottom period in 1976. Since that year the production total of machine tools has increased about three times and continued to grow for four consecutive years.

Of the total, the output of numerically controlled (NC) machine tools which has attracted world attention, amounted to 339.4 billion yen or a 65 percent increase over the previous year. The ratio of NC machine tool production to the total machine tool production is almost 50 percent and the highest in the world. The production weight amounted to 275.000 tons or a 25 percent increase over the preceding year. However, this was a 23 percent decrease when compared with the peak year in 1970.

As a reference, the 1980 production of machine tools prepared by the American Machinist showed that the U.S. was in first place with $3.78 billion followed by West Germany in second place with $3.26 billion, Japan in third place with $3.0 billion, the Soviet Union in fourth place with $2.41 billion and Italy in fifth place with $1.14 billion.

Sales

Sales statistics prepared by the Ministry of International Trade and Industry showed that sales amounted to 680.5 billion yen which was a 39 percent increase over the preceding year. The figure indicates a continuous increase for five consecutive years.

Inventory

Statistics prepared by the Ministry of International Trade and Industry showed that as of March 1981 the machine tool inventory was 16,000 tons or a 26 percent increase over the preceding year. The figure represents a 0.6 month supply which is an appropriate inventory on the average.

Exports

The Finance Ministry's customs clearance statistics for 1980 showed that exports of machine tools were favorable and amounted to 269.6 billion yen or a 30 percent increase over the previous year. Since 1976 exports have shown a remarkable increase. Although Japan's machine tool exports have been shipped to markets all over the world, there are some problems because the market share has centered on the U.S. and European areas and has not spread fully to other areas. Also, there has been a sharp rise in exports in recent years with the majority of exports consisting of NC machine tools.

NC machine tool exports amounting to 172.8 billion yen account for 64 percent of the machine tool export total of 269.6 billion yen, an increase of 73 percent over the previous year.

Exports toward Europe amounted to 70.1 billion yen or 26 percent of the whole share, those toward North America 113.1 billion yen or 42 percent and those toward other areas 86.4 billion yen or 32 percent.

The 1950s was an era of imports because the 1957 Japanese export ratio registered only 5 percent while imports totaled 45 percent.

During the first half of the 1960s a similar trend continued but since the latter half of the 1960s Japan entered into an age of self-sufficiency structure (13 percent export ratio and 11 percent import ratio in 1972). Since then this country has turned into a full-scale machine tool export country from the mid-1970s.

In the above process, the machine tool industry has been endeavoring to develop high performance and high precision models which can be relied on by users. Greatest efforts were made to promote technical development while struggling to open up both domestic and overseas markets through market surveys, before- and after-sale service studies and sales base establishment.

The present status of Japanese machine tool industry, therefore, cannot be attributed to the "so-called" dumping acts but to the accumulation of export knowhow gained after a series of trials and errors.

In other words, the industry is now actually on a steady road toward expansion on the basis of confidence by users all over the world in terms of performance, precision, prices, punctual delivery and competent after sales service.

On the other hand, it is true that various criticisms have started to be aimed at Japan due to the fact that the timing of full-scale export expansion occurred during the latter half of the 1970s.

Unfortunately, this fell on the recession period in all the advanced nations and the machine tool industries in all Western countries, except the United States and West Germany were not necessarily brisk while technical development for NC machine tools in those countries lagged considerably behind their Japanese counterparts.

We should make an effort to establish friendly co-existence with foreign counterparts throughout the world through greater development and supply of such models which can contribute to the promotion of the machine tool industry of the world while listening to the voices of foreign counterparts in a serious manner and maintaining the free-trade principle in a free economy.

We will continue to export products in a satisfactory fashion in the future. NC lathes and machining centers are currently exported to the United States and European countries under the Japanese Government's minimum export price regulations. They have been decreasing in both areas after the peak period in mid-1980.

Today, the age of merely exporting manufactured goods from Japan has passed and it is expected that further efforts will be made for local production, capital participation and technological transfer in every consumer nation.

Imports

Japan which used to be an importing country of machine tools, has now changed to an exporter as stated earlier. In 1980, Japan's import total amounted to 38.2 billion yen or [illegible]6 percent of the preceding year, marking its import dependence ratio at 8.5 percent. The average rate for the past five years from 1975 to 1980 registered 8.4 percent.

Most imports come from the three nations of the U.S., West Germany and Switzerland, occupying 77 percent of the Japanese import total.

Imports from the U.S. amounted to 9.6 billion yen or a 64 percent increase over the previous year, West Germany 11 billion yen or a 12 percent increase and Switzerland 8.3 billion yen or a 75 percent increase.

Other leading countries include South Korea, Taiwan and Singapore.

The characteristics of imported machine tools involve high precision, ultra-large and special performance types as well as small models, multi-purpose lathes or the so-called 'low-price products' which cannot be produced in Japan.

It can be generally said that foreign makers' sales efforts of machine tools on the Japanese market seem to be insufficient.

It may be necessary for them to strive to encourage Japanese users to purchase their products through positive participation in trade shows held in Japan by exerting greater ingenuity in an increased number of exhibit models.

The above report gives a general picture of Japan's machine tool industry by reviewing each field of orders, production, inventory, exports and imports.

Since the Japanese machine tool industry, as mentioned above, has established a leading position in the world, it is hoped that we will be able to secure a means of coexistence with our foreign counterparts.

We should fully realize this position and contribute to the world economy by possessing reflective thoughts so that our actions will be properly assessed as worthy of being called "world businessman." ■

CSO: 4120/74

SCIENCE AND TECHNOLOGY

MACHINE TOOL BUILDERS COMMENT ON INDUSTRY

Tokyo DIGEST OF JAPANESE INDUSTRY AND TECHNOLOGY in English No 164, 1981 pp 17-21

> [Text] The following are the answers for which DJIT has put questions to leading machine tool builders here. Full responsibility on the contents depends on DJIT. --Editor

[Comments by Shozo Koyama, chairman, Dainichi Kinzoku Kogyo Co., Ltd.]

On Overseas Advance

Requests for plant construction from New York, Illinois, Miami, Los Angeles and Seattle are now under study, but it is considered essential for us to realize local production in one way or the other.

The State of New York is enthusiastic in inviting manufacturing plants and within this scope we are planning to work out our basic policy toward the issue including the problems of manpower and wage in Chicago and Detroit.

On Future Marketing Policy

First joint-venture company has already been established in South Korea and the second in Singapore.

All the ASEAN countries, therefore, are being considered similar projects.

In the U.S., NC machines are playing a major role while the multi-purpose machines in Singapore. The machine tool industries in local circles have been proceeding with their advance in the NC field. Accordingly, we are taking positive steps in receiving trainees from these countries because we believe that Japanese machine tool industry should encourage overseas expansion.

On Future Key Export Lines

The NC machine will be shipped mainly to the U.S. while exports toward Singapore will start with multi-purpose machines and gradually shift to the NC machine.

On New Technological Developments

It is particularly essential to develop technologies for aircraft machine tools. It is expected that NC and robot development will be steeped up while efforts for labor-saving and unmanned operations will be further encouraged.

On Steps for International Cooperation

My theory of supporting international division of labor has been long and has been voiced many times. The question is how we should carry out international division of labor.

From an international point of view, it will be ideal for Japan to be in charge of 'process technolgy' which is its strong point. It is, however, necessary at first for Japanese domestic manufacturers to consult each other, centering on the Japan Machine Tool Builders' Association. After this, a system for the international division of labor should be discussed chiefly among Japan, the U.S. and the EC. This will be a big task for us in the future.

[Comments by Seiji Okoshi, manager, International Operations, Precision Machinery Division, Second Machinery Headquarters, Mitsubishi Heavy Industries, Ltd.]

On Overseas Advance

Mitsubishi's local corporation called Mitsubishi Heavy Industries America has established sales and service bases in Atlanta and Detroit while in Europe, sales and service activities are being exercised at its Paris office.

In regard to local production, it is presumed that long-term views of such problems as trade friction, prompt service to customers and yen exchange, indicate that some form of local production will have to be carried out in the near future.

In an attempt to establish a local corporation, positive sales activities will be practiced first and then a local base will be set up.

On Future Marketing Policy

Focal markets will be Latin America, England, West Germany, France, Switzerland and the Scandinavian countries. The Soviet Union and Eastern Europe will also be targets.

In the past, a considerable amount of sales to these countries has been recorded but it will be necessary to cope with them in light of their economic status and 5 to 10-year programs.

In any event, it is true that there are three main markets consisting of the U.S., Europe and the Soviet Union plus Eastern Europe.

Due to the aggravated foreign currency situation, few transactions have recently been conducted toward the South Korean market where Mitsubishi Heavy Industries has already made inroads into the automobile related field. If its economy turns favorable, exports to South Korea will be activated.

On Future Key Export Lines

Horizontal boring machines has recorded good sales results in the U.S. It is predicted that the single unit of NC machines, large machining centers and large processing systems equipped with processing knowhows, transportation devices and tool-exchanging apparatus will expand sales. For the Western nations, small-sized machining centers (mainly of the horizontal type) constitute a key model.

Besides, there is gear hobbing machines designed for gears to be used for automobiles, agricultural and construction machinery.

In addition to the above, the multi-spindle automatic turning machines technically licensed by National Acme Co. of the U.S. is being mainly exported to the socialist countries including the Soviet Union.

On New Technical Developments

The much-publicized FMS (Flexible Manufacturing Systems) has now been put on the domestic market and its sales results will determine the possibility of future exports. Since we have already obtained actual sales results, there is no anxiety about the FMS, but it is our desire to employ a system where orders can be received in one body because it is necessary for us to prepare various combinations suitable to differing needs from customers.

Robots comprise two kinds of models for painting and welding, whose techniques are also being transferred from National Acme Co. and Warner Swasey Co. of the U.S.

On Steps for International Cooperation

A look at the history of the machine tool industry will compel us to take a choice of international division of labor. It is considered that Japan's role will focus on NC small-sized machine tools and a certain degree of quantity control and self restraint will be indispensable.

In the U.S., such a trend can be seen to some degree. For instance, the production of machine tools which requires highly advanced technology for aircrafts proves to be a good example.

[Comments by Minoru Matsuda, engineer manager, Overseas Operations Section No 2, Administrative Section, Export Division, Mitsui Seiki Kogyo Co., Ltd.]

On Overseas Advance

Mitsui Seiki Kogyo has been exercising technical licensing with foreign manufacturers since the 1960s including the French Government-managed Renault's Plant Administrative Bureau in 1957, U.S. Excello Corporation in 1963, Pratt & Whitney Inc. in U.S. in 1970, etc.

We have especially advanced into the Soviet Union at the same time as France. Therefore, its history of overseas advance is quite long. The key marchandize was jib borers at the start. At present, sales and service in Europe are based on Mitsui Seiki Europe S.A. while in the U.S., machining centers, jib borers and jig grinders are mainly being marketed through Mitsui & Co.

Although technical tie-ups with overseas capitals have long been practiced, there exist various problems beyond control, particularly, in terms of management because in actuality, high productivity similar to that now envisioned in Japan could be hardly expected without complete adoption of Japanese type management.

On Future Marketing Policy

It is hoped that the U.S. Midwest and South Africa will be the target of our overall export efforts.

As far as the developing countries are concerned, the current steady development efforts will be pursued for opening markets in this field.

On Future Key Export Lines

This category includes machining centers, jig grinders, NC screw grinders. About half of these exports will be shipped to the aircraft industry.

On New Technical Development

FMS will play a key role in the development of new techniques. Future technical advancement will be directed toward 100 percent unmanned operations with development of peripheral equipment proceeding simultaneously.

As the development of a monitoring system is important, it is expected that techniques for tool breakage prevention and automatic measurement functions will be raised to higher levels in the future.

On Steps for International Cooperation

International coordination is considered necessary because if the machine tool industry fails to work together, it could suffer a setback.

It is, therefore, essential to establish a form of cooperative structure through some effective measures, especially under the leadership of MITI (Ministry of International Trade and Industry).

[Comments to Hajime Okuma, director & manager, Export Department, Okuma Machinery Works, Ltd.]

On Overseas Advance

It has become necessary to possess a production base no matter in what form in major overseas markets.

From the viewpoint of trade friction, production bases play an important role in achieving local production, local procurement of devices, enlargement of local employment opportunities, cooperation with local manufacturers and a positive sales posture to sell products on good terms.

In addition, local production is indispensable because of the need for service function as well as special function to manufacture products which meet local requirements. Local production is also necessary to collect information on new techniques and new machine development.

On Future Marketing Policy

The current share of overseas markets is 45 percent for Europe, 40 percent for the U.S., and 15 percent for Australia, Taiwan and South Africa.

It is expected that the ratio of the U.S. market will become larger and larger in the future because of increasing sales in oil-related industries and the aircraft industry.

On Future Key Export Lines

The NC lathe has occupied the majority of exports so far, but in the future the machining center is expected to increase sharply. In other words, exports will center on NC lathes, machining centers and NC grinders. Since our company has produced its own NC equipment, we are able to assemble FMS under our own technique, thus allowing smoother FMS production and development of a 'more flexible' production system.

On New Technical Development

Our techniques which have been put to practical use, include automatic measuring technologies, automatic tool control system, automatic transportation system in a broad sense (for instance, robots, loaders, conveyors, etc.)

Although still in the experimental stage, a robot equipped with the pattern sensor is now in the R&D stage.

On Steps for International Cooperation

It is most important to exchange techniques and capital by establishing a cooperative system with local industries, through the offering of designing and production techniques while locally procuring labor, capital, production equipment and parts from related industries on the other side.

Since the machine tool has a special character, it is believed that international cooperation will be limitedly needed by the Western advanced countries because the growth rate of technical standards and related peripheral equipment should be thoroughly taken into consideration.

[Comments by Shigeru Ohta, managing director, Osaka Kiko Co., Ltd.]

On Overseas Advance

Requests for building plants from Europe in particular are now under careful study. Joint venture possibilities which involve various business treatments, differ in terms and conditions between nations and involve the marketing territory issue, are also under further examination.

On Future Marketing Policy

The U.S. and European markets are now in the process of development. In the future, Australia, South Africa, India and Israel will be considered as prospective markets in view of broadening the export base. At the same time, we are studying the development of the socialist markets.

On Future Key Export Lines

Vertical&horizontal MCs, multi-purpose millers and NC milling machines are involved in this category.

On New Technical Development

It is expected that further development of new techniques for greater unmanned operations will advance in the near future. Greater application of robots and technical revolution for peripheral technology will accelerate labor-saving efforts.

On Steps for Internation Cooperation

A general view seems to be that it is absolutely necessary to maintain orderly marketing policy as improper price dumping will cause trade frictions. Such improper business practices represent a problem. It is a problem of management conscience. Unfair sales tactics by a few which are currently being done even at domestic market will put the industry as a result in trouble.

[Comments by Tsuguo Suzuki, managing director, Seiki International Co., Ltd., Export Division of Hitachi, Seiki Co., Ltd.]

On Overseas Advance

Our company has started partial production of NC lathes in New York State from January 1980. The production volume is still small but we would like to make it an important overseas base in the future. Furthermore, in April 1981 we have constructed a new factory in Congers, New York which has started production. At present the company employs about 70 workers in the combined production, sales and service fields. The monthly production capacity is 12 to 13 NC lathes with plans to increase monthly production to 20 units before the end of 1981.

The main reason for carrying out local production is to provide a feeling of trust to local users. In the machine tool field, the most important thing is to win confidence which includes the technical and service fields.

Through the start of machinery production, it is possible to accumulate technical knowhow in production of peripheral equipment and systematization and to easily realize locally FMS which is our future policy course.

The other reasons are the need to overcome foreign exchange problems, personnel costs and rising parts costs. Local production has its merits on the cost side because it reduces cost price differences between the U.S. and Japan.

Future Marketing Policy

The current market distribution shows the U.S. in first place with 50 percent followed by Europe with 30 percent and others with 20 percent. The future plan is to establish the export proportion to the U.S. at 30 percent and increase exports to the Far East and Southeast Asian markets. There is also a plan to develop promising markets in the Soviet Union, Hungary, Yugoslavia and Bulgaria.

On Future Key Export Lines

As mentioned earlier, NC lathes and machining centers are expected to become the principal export items in the future. However, the trend appears to be greater rather "system exports" than machinery ones.

On New Technical Development

The ultimate goal of technical development calls for complete automation and unmanned machinery operations. Future development is expected to center on FMS for large-variety small-quantity production. For example, the development of devices using laser beams will lead to higher speeds and stronger horse power for single-unit machines.

Furthermore, exports of aircraft industry-use machine tools are expected to increase during the next five to six years such as the five-axle machines of large machining centers because of sound demands from the aircraft industry.

By fitting machinery processing knowhow into NC equipment, it has become possible for untrained workers to operate various types of machines. Although the quantity of NC machinery is still small, some users have installed these machines which indicate that fixed NC machine tools will increase more and more in the future.

On Steps for International Cooperation

In the past, Europe has been the center of machine tools with many makers in the area operating factories with 300 to 500 workers. Therefore, it is possible that NC lathes and machining centers among machine tools exported to Europe will cause friction if exports increase suddenly and become targets of import restriction moves. The EC has already started watching imports of Japanese machine tools.

On the advancement of factories in Europe, there is little merit because the machine tool industry's condition is different from the situation in the U.S. A concrete measure which can be considered, is to engage in joint sales with local makers or carry out technical tie-ups. There are considerable mutual benefits if tie-ups with local makers are carried out by taking such measures as the joint development of new products.

[Comments by Shigemitsu Asai, president, Toyoda Machine Works, Ltd.]

On Overseas Advance

Although Japanese machine tools have grown into an international product, there have been growing voices advocating protectionism in the U.S. and European markets. In order to secure stable exports in the future, it has become necessary for Japanese machine tool makers to carry out local production, provide technology and engage in joint ventures by cooperating with importing nations.

There is also the problem of international division of labor from the international competitive power viewpoint. In considering what country is the best in the world from the cost side, it cannot be necessarily said that cheap labor will emerge as the winner in international competitive power.

Unlike the equipment industry, machine tools have high technical skills to a certain degree which makes necessary such conditions as peripheral facilities with high productivity and comparatively easy access to materials. Even if overseas advance is carried out because of cheap labor costs, the cost of finished product will be high.

Our company has established the TKB (Toyoda Koki Do Brasil) local company because of anticipation of future industrialization and development of abundant resources in Brazil. As a preparatory step toward the production of multi-purpose machine tools, Toyoda Machine Works has started with a factory producing automatic lathes.

At the same time, the company has established a joint venture company in France by joining hands with Somua which is a local machine tool maker . The HES-Toyoda has started production of machine tools including MCs.

On Future Marketing Policy

There will be growing demand for NC machines, FMS, etc., because of moves toward unmanned and labor-saving machines as well as diversity in market development of such bright industries as electronic and aircraft industries. Therefore, we think that there is need to develop markets for these machines.

Our company's grinding machines are expected to turn to CNC grinders on an increasing basis. The supply and demand gap in the North American market is expected to be narrowed in the near future and multi-purpose machines which have international competitive power are expected to become the main products.

In Europe, the sales route will be expanded through HES-Toyoda. There must be caution in dealing with the Soviet Union and East European countries because of political risks. Exports in this area will consist of advanced machines. They will center on grinders including specialized machines.

On Future Key Export Lines

Grinding machines and machining centers will become the principal export machines. It is believed that the competitors will not be the local makers in that country but Japanese companies carrying out local production by building factories in the country. It is also possible to export FMS.

On Technical Development

There has been a growing trend toward the use of unmanned and diverse machines through the application of electronization, CNC, FMS, CAD/CAM robots, etc. We must work out countermeasures to develop machines to cope with the development of new processing materials such as fine ceramics and new sophisticated elements, and industries expanding in the future.

On Steps for International Cooperation

Since it is not possible to consider the position of only one country in the machine tool industry today, it is necessary to stand on a premise of mutual prosperity. Machine tools are key industries in every nation. Therefore, Japan should not forget that importing machine tools from other nations will contribute to their prosperity. Concrete measures include international division of labor by machine type, local production, technical export, joint development and price policy. ■

CSO: 4120/74

SCIENCE AND TECHNOLOGY

MARKET TRENDS OF MACHINE TOOL INDUSTRIES

Tokyo DIGEST OF JAPANESE INDUSTRY AND TECHNOLOGY in English No 164, 1981 pp 25-28

[Text]

Machine Tool Builders Start to Expand Sales Networks

Japan's machine tool industry has been caught up in a boom for the last five years and it has started to sing the praises of unprecedented success. The main pillars of the boom have been NC lathes and machining centers and today, when two-thirds of 1981 has already passed by, the continual entry of manufacturers into the production to these two types of machine has served to intensify sales on the domestic market. Some manufacturers have even gone so far as to endeavor to get to grips with the situation by cutting their prices.

Production Trends of Machine Tool Units in FY 1980 (Unit: million yen)

Item	Quantity	Amount	Comparison with previous year (%)	Inventories
Mechanical clutch	29,342	809	108	5,092
Electromagnetic clutch	3,178,283	20,088	121	181,468
Lead screw	489	47	–	0
Ball screw	111,610	9,906	024	0
High-speed transmission shaft	4,203	563	83	0
Other parts	4,504	672	–	0
Parts total	3,328,431	32,085	140	186,560
Dividing head	8,245	1,003	141	1,230
Rotary table	6,837	1,326	141	429
Machine vise	23,051	924	113	4,551
Other accessories	38,717	579	449	1,143
Accessories total	76,850	3,832	148	7,353
Scroll chuck	91,510	3,288	106	10,641
Four-click independent chuck	9,275	737	109	1,736
Miscellaneous hand operated chuck	15,622	329	133	151
Power operated chuck	39,917	4,401	166	6,477
Magnetic chuck	15,068	1,699	119	1,149
Collet chuck	5,830	93	–	3,490
Live center	45,680	475	111	7,650
Miscellaneous work holding device	299,272	852	131	7,052
Work holding device total	522,174	11,874	88	38,346
Collet	487,488	2,132	–	7,714
Holder	212,731	5,712	158	2,688
Sleeve/Socket	126,432	708	64	2,001
Arbor	49,937	616	99	1,312
Drill chick	1,923,596	2,815	112	174,944
Miscellaneous tool holder	412,281	3,091	131	2,138
Tool holder total	3,212,465	15,073	196	190,798
Coolant separator	3,778	370	152	155
Miscellaneous accessories	30,597	540	–	0
Accessories total	34,375	910	–	155
Grand total		63,774	137	

(Source: Machine tool unit manufacturers Association of Japan)

More and more individual manufacturers are setting their sights on expanding their shares of the domestic NC machine tool market and have started to expand both their domestic sales and servicing networks. One prime example is Mori Seiki, one of the nation's top builders of lathes. It aims to increase the number of domestic offices from eight to eleven before the end of the year. Another example is Osaka Kiko which is said to plan to increase the number of sales bases to 19 by the close of the accounting year ending May 1982 and, in addition, it is paying far more attention to its after-sales servicing than before. Okuma Machinery Works has decided to give test runs of its NC machine tools at its sales bases nationwide, set up "NC Centers" where on-the-spot training can be provided and open showrooms in areas heavily populated with users by means of separate companies.

This series of moves is seen as a prompt reaction on the part of the manufacturers to the fact that the domestic demand for machine tools slumped during the second quarter of this year below the level set in the same quarter of last year for the first time in five years. Manufacturers have come to the common awareness that the way to overcome competition on the market lies not only in providing products with a high quality but also in offering to users good service and in particular services which match the technical sophistication in machine tools.

In reaction to this build-up of networks by manufacturers, the dealers of both machines and tools which control most of the domestic distribution of Japan's machine tools see this as a threat to their own standing and, against the backdrop of increasing technological sophistication, it remains of interest to see exactly how these dealers will tackle the latest offensive launched by machine tool makers.

Machine Tool Unit Market

According to the Machine Tool Unit Manufacturers' Association of Japan, the production of machine tool units in 1980 increased by 37 percent to 63,774 million yen over the previous year with shipments jumping 35 percent to 64,564 million yen.

The fast-paced growth in the production of machine tool units is accounted for not only by the boom in machine tools but also by the broad-based increses in the production and shipments of products related to numerically controlled machines.

One example is ball screws which are indispensable not only to machining centers but also to other NC machines. In 1980 their production more than doubled to rise by 104 percent to 9.96 billion yen over the year before. The production of other items also increased rapidly: round tables (up 41% over the year before), holders (up 58%) and coolant separators (up 52%). In each case, the increases were a reflection of the growth in the demand for NC machines.

In 1979 the members of the Machine Tool Unit Manufacturers' Association of Japan numbered 46 but this jumped to 58 in 1980. The advances made in adopting NC techniques into machine tools have brought far-ranging changes to the production set-ups of manufacturers.

Drilling Machine Market

Drilling machines are used to make holes in metal and it was once thought in Japan that they would be replaced in the not too distance future by machining centers.

However, compared with other machine tools, their unit price is low and so there has been a constant renewal demand from small-scale machine manufacturers. As a result, the builders of drilling machines have adopted at the moment a full production set-up centering on radial type machines. In terms of value Japan's general-purpose drilling machine market was worth 7.6 billion yen in 1977, 8.4 billion yen in 1978, 10.5 billion yen in 1979 and 11.5 billion (currently about 230 yen level to the dollar) in 1980 (with 40,202 units), which is an annual growth rate of more than 10 percent. The demand this year is expected to rise about 20 percent in value over the figure established last year with a projected increase in quantities equivalent to 11 percent. These are the generally quoted predictions by the industry circles.

There are several factors which are responsible for the deep-rooted demand for drilling machines as noted by industry sources:

1) the ongoing equipment renewal among the users who cannot afford to purchase high-priced machining centers,

2) the heavy burden of machine depreciation for users with high-priced machining centers seeing as the machine costs for drilling work are low,

3) the fact that no skilled workers are required as they are with other machine tools.

To cope with the rising demand, the drilling machine builders are streamlining their production processes and implementing out-and-out planned production. No moves are being made with plant and equipment investments.

Yet while numerically controlled machines are taking this island by storm, the fact that there is a continued deep-seated demand for general-purpose machine tools such as the drilling machines is an indication that the base line of the industry will be expanded even further as Japan's machine tool industry comes to the one trillion yen market on an annual production basis.

Cemented Carbide Tool Market

The Japan Cemented Carbide Tool Manufacturers' Association recently announced the production and shipment figures for cemented carbide tools in 1980. Accordingly, the total production of cemented carbide alloy tips came to 165.5 kg which represented a 7.4 percent increase over the previous year. This breaks down into a 14.5 percent increase over the year before for cutting applications, a leveling-off for anti-corrosion applications with a mere 0.5 percent rise, and a 2.9 percent decline for mining and civil engineering applications. The shipments of marketing tips and molded tools rose 26 percent over the year before to 102.8 billion yen. Exports were up by 11.7 percent over the same period to 7.8 billion yen.

Inventory Trends

The Japan Machine Tool Builders' Association recently released the fact-finding survey on production figures for NC machine tools in 1980. A total of 63 leading members of the Association were surveyed. According to this survey, the production and shipment quantities of NC machines in 1980 rose sharply over the levels set in the year before but at the end of the year the total inventories jumped just over 30 percent on a year-to-year basis. In particular, there were large-scale increases in the inventories of NC lathes and machining centers, which was evidence of excessive supply.

Inventories stood at 1,191 units worth 17.7 billion yen, increases of 32.5 percent and 38.1 percent over the year before. In terms of the quantity and value of the average shipments per month in 1980, they represented only 75 percent and 66 percent of the figures per month, respectively and now they do not pose any particular problems for the future. Yet about 90 percent of all the inventories are NC lathes and machining centers—in contrast to NC milling machines and grinders which have reduced inventories—which leaves no doubt that these particular machines are in a state of excessive supply.

Production, Shipments & Inventories of NC Machine Tool

(Unit: quantity/set, amount/million yen)

Type	Production		Performance in 1980 Shipments		Inventories		Production plan in 1981	
	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
NC lathe	9,911	137,789	9,637	137,400	737	9,053	9,231	126,715
NC drilling machine	195	1,798	195	1,808	11	214	293	2,345
NC boring machine	158	11,600	147	11,083	14	572	202	13,939
NC milling machine	1,775	23.910	1,748	23,768	58	533	2,784	42,941
NC grinding machine	183	4,420	189	4,471	30	540	375	9,420
NC special purpose machine	113	6,022	116	6,153	14	241	139	9,383
Machining center	4.820	108.902	4,691	107,697	242	6,279	6,417	145,378
NC electric spark machine	2.335	29,571	2.350	29,561	85	293	3,783	45,715
Others	54	1,345	54	1,345	0	0	33	1,725
Total	19.544	325.357	19.127	323.286	1,191	17,725	23.257	397.561

CSO: 4120/74

TRENDS IN METAL FORMING MACHINE INDUSTRY

Tokyo DIGEST OF JAPANESE INDUSTRY AND TECHNOLOGY in English No 164, 1981 pp 37-42

[Article by Hiroyasu Kagawa, managing director, Japan Metal Forming Machine Builders' Association]

[Text]

General

The forming machine belongs to the same category as metal working machinery or machine tools. It is broken down into many types according to the processing method. (However, in Japan, each industry of machine tools and forming machines forms the association independently – editor)

The most widely used types are mechanical presses, hydraulic presses and sheet metal cutters as well as various machines for powdered molding, forging and extrusion molding. There are also wire-forming machines for wire-material processing.

The forming machine requires special quality technology in order to manufacture on a large scale, uniform shaped and high-precision products in an economical manner. The machine must also produce raw molding materials which are very hard, and large molding materials. Because of this special characteristics forming machines are important production goods in the machinery industry especially in the automobile and electric machinery industries which are mass-production oriented industries.

Japan's forming machine technology has made remarkable progress during the past 20 years accompanied with the development of the automobile and electric machinery industries which are main customers.

The advance technology of Japanese forming machine industry has also been highly appreciated at overseas markets including advanced countries and developing countries. We are convinced that our forming machines have been contributed to the industrial development of these countries.

The primary objective of forming machines focused on constant industry efforts to improve the level of high speed, automation and high precision of the machines together with the promotion of technical development to produce many types of machinery in recent years. For example, the development of automatic exchange systems for metal patterns and materials, and industrial-use robots have made progress as domestic user circles have shown a very positive stand toward induction of new systems and products.

In addition, there are new tasks which include the development of energy-saving forming machines and countermeasures to prevent labor accidents. By making progress in forming machine technology and coping with new tasks, it is believed that the industry will be able to assume an important role in the industries of many countries of the world.

Business Trends

The major forming machine builders are members of the Japan Metal Forming Machine Builders' Association. Over 100 companies are members of the Association.

Depending on the size of the forming machine products as well as diversity of the machines and large and small demand volume, the scale and structure of the makers have varied greatly. The makers range from super-large businesses such as shipbuilding and steel production to small companies with about 20 to 30 workers with each respective business carrying out production activities under its own technical know-how.

Since the forming machine industry is a capital goods industry which has a demand field covering the broad machinery industry, it is easy for its demand to receive major effects of business trends from time to time.

In recent years, our industry received a big blow during the so-called first oil shock in 1973. Since then, demand continued to rise smoothly until the production total reached a new high in 1980 amounting to about 190 billion yen in value (currently about 230 yen level to the dollar). A breakdown of the main products showed that about 14,000 press machines and 6,700 hydraulic presses were manufactured during the year. The 1981 production total is expected to exceed 200 billion yen.

The principal reason for production increase was attributed to rationalization investments in such industries as automobile and automotive parts, and electric machinery and equipment. In addition, there was large contribution by mechanical press investments in internally-equipped safety functions.

The scale of forming machine exports amounted to between 50 billion yen and 60 billion yen in 1980. The machines were exported mainly to the U.S. and Southeast Asian countries. The export trend showed that most of the large types such as plants were shipped to the U.S. and the socialist countries while the small and medium multi-purpose machines were exported to Southeast Asian countries.

The trend of forming machine imports is entirely subject to the domestic business situation, marking a sharp decrease during a recession.

FY 1980 imports (during the April 1980 to March 1981 period) registered about 12 billion yen or a continuing increase. Currently, major imported models include the high-speed forming machine and other speciality machines mainly from the U.S. and West Germany. Most of them are internationally well-known products.

Technical Trends

The contents of technical development which the forming machine industry has so far achieved can be broken down into the following three segments:

1) Improvement of high precision and reliance,
2) Higher productivity through high speed and automation.
3) Compliance with new needs accruing from the development of new technologies.

These three technical developments have ensued a variety of evolutions including high-speed and high-precision press, cold forging process, transfer press, automatic materials supply and automatic mold-changing systems.

In addition, our industry has taken positive steps recently toward environmental and labor safety measures which constitute one of the most important tasks among industrial circles.

Although many research institutes and industrial associations have been exercising a fundamental study for low-noise, low vibration measures, it appears necessary to continue a great deal of studies on an accumulating basis in the future before any economical and effective measures for low noise and low vibration can be attained.

During the past few years, safety measures for press machines have been pursued positively through Japanese Government regulations as well as subsidies and through the efforts of user industries.

In other words, a series of comprehensive safety measured aimed at the machinery industry as well as user circles are at present in progress.

They include the compulsory installation of safety measure press machines, the execution of model licensing systems for safety function-equipped presses, financial subsidies for the above installation cost and compulsory check of press machinery on regular basis.

The direction of the technical development of the Japanese forming machine industry is now heading can be divided into the following three:

1) Development of new metal plastic processing techniques,
2) Automation and multiple techniques for the purpose of multifarious production,
3) Development of energy conservation.

In addition to these three, it is predicted that measures against noise and vibration as well as measures for safety will remain a constant task in terms of future technical development.

In planning advanced forming machine production on the basis of the Law on Extraordinary Measures for Promotion of Specific Machinery and Information Industries through the Ministry of International Trade and Industry as a window organ, the machinery industry has been endeavoring to pursue research and development by establishing various tasks for development and industrialization of new products.

Major items among them include further industrialization of:

1) Index-controlled automatic forging equipment,
2) Index-controlled automatic free-type forging equipment,
3) Hydroforming press-type index-controlled forming machine.

The Japanese forming machine industry is constantly seeking new tasks and trying to resolve them by meeting all requirements accruing from prevailing economic conditions and user circles.

It is, therefore, expected that the industry will greatly contribute to the development of the industrial circles of the world in the future. ■

Production Trends by Machine Type (Unit: million yen)

Type \ Fiscal Year	1974	1975	1976	1977	1978	1979	1980
Bending machines	4,144	3,716	5,278	4,088	3,390	4,306	5,091
Hydraulic press	28,324	16,480	16,661	21,489	24,779	33,454	35,112
Mechanical press	58,419	33,040	53,906	68,468	71,394	96,089	109,827
Shearing machine	15,925	8,469	13,773	12,549	14,725	16,549	22,510
Hammer	1,164	1,642	1,037	1,349	1,872	1,343	1,417
Other forging machine	2,749	2,436	2,672	2,838	7,126	3,404	4,880
Wire forming machine	11,771	6,863	7,969	6,154	8,058	7,888	10,789
Total	122,496	72,646	101,296	116,935	131,344	163,033	189,626

Source: 'Machinery Statistics' (MITI)

Trends of Production & Exports and Imports (Unit: million yen)

Fiscal year beginning in April	Production		Exports		Imports	
	Unit	Value (A)	Value (B)	(B/A)	Value (C)	(C/A)
1969	23,218	76,459	6,878	9.0(%)	14,186	18.6
1970	24,664	87,512	9,226	10.5	14,095	16.1
1971	15,520	62,325	15,070	24.2	13,370	21.5
1972	21,972	72,177	16,372	22.7	7,173	9.9
1973	28,134	109,052	25,830	23.7	10,030	9.2
1974	20,283	122,496	32,460	26.5	15,778	12.9
1975	12,489	72,646	32,686	45.0	12,797	17.6
1976	16,720	101,196	39,504	39.0	7,444	7.4
1977	16,529	116,935	50,151	42.9	6,881	5.9
1978	19,755	131,344	50,358	38.3	6,004	4.6
1979	24,967	163,033	68,064	41.7	10,599	6.5
1980	29,110	189,626	60,953	32.1	11,656	6.1
1981 outlook	–	210,000	60,000	28.6	12,000	5.7

Source 'Machinery Statistics' (MITI) Customs Clearance Statistics (MOF)

The List of Leading Metalworking Enterprises in Japan

AICHI TOKEI DENKI K.K.
1-2-70, Chitose, Atsuta-ku, Nagoya

AMADA COMPANY, LTD.
200, Ishida, Ischara City, Kanagawa Pref.

ASHINA IRON WORKS, LTD.
945, Hirotani-cho, Fuchu City, Hiroshima Pref.

AZUMA SHIMAMOTO ENGINEERING CO., LTD.
2-132, Momoyama-cho, Niigata City, Niigata Pref.

CITIZEN WATCH CO., LTD.
840, Shimotomi-takeno, Tokorozawa City,
Saitama Pref.

DAIDO MACHINERY, LTD.
9, Takiharu-cho, Minami-ku, Nagoya

DAINICHI KINZOKU KOGYO CO., LTD.
Shin Osaka Bldg., 1-1-36, Nishi Awaji-cho, Higashi
Yodogawa-ku, Osaka

DAIWA SEIKI CO., LTD.
1-270, Higashi Onari-cho, Omiya City, Saitama Pref.

EGURO MACHINERY CO., LTD.
8-14, Okura-machi, Okaya City, Nagano Pref.

ENSHU LTD.
4888, Takatsuka, Kami-mura, Hamana-gun, Shizuoka
Pref.

FUJI MACHINE MFG. CO., LTD.
19, Chausuyama, Yama-machi, Chiryu City, Aichi
Pref.

FUJI SEIKI CO., LTD.
981, Uenonishiwaki, Ageo City, Saitama Pref.

FUJI-SEIKI MACHINE WORKS, LTD.
840, Shimotogari, Nagaizumi-cho, Sunto-gun,
Shizuoka Pref.

FUJITSU FANUC LTD.
3-5-1, Asahigaoka, Hino City, Tokyo

HAMAI CO., LTD.
5-5-15, Nishi Gotanda, Shinagawa-ku, Tokyo

HAYAKAWA MACHINERY WORKS, LTD.
32-56, Nagane, Daikoji, Chita City, Aichi Pref.

HITACHI SEIKI CO., LTD.
1, Abiko, Abiko City, Chiba Pref.

HITACHI SEIKO LTD.
890, Kashimada, Saiwai-ku, Kawasaki City,
Kanagawa Pref.

HOKOKU MACHINERY CO., LTD.
1008. Kusado-cho, Fukuyama City, Hiroshima Pref.

HOMMA METAL WORKS CO., LTD.
3-7-2, Tagawa, Yodogawa-ku, Osaka

HORI MACHINE TOOL CO., LTD.
3-8-12, Oshiage, Sumida-ku, Tokyo

HOWA MACHINERY, LTD.
Sukaguchi, Shinkawa-cho, Nishikasugai-gun,
Aichi Pref.

ICHIKAWA GRINDER MFG. CO., LTD.
283, Michishita, Kagiage Shinden, Iwatsuki City,
Saitama Pref.

IIDA MACHINERY CO., LTD.
2-15-14, Mishuku, Setagaya-ku, Tokyo

IKEDA IRON WORKS, LTD.
3-6-23, Nishi Gotanda, Shinagawa-ku, Tokyo

IKEGAI IRON WORKS, LTD.
4-1-21, Shiba, Minato-ku, Tokyo

ITO SEISAKUSHO CO., LTD.
6-4-11, Nishi Oi, Shinagawa-ku, Tokyo

JAPAN ABRASIVE CUTTING MACHINE MFG. CO., LTD.
Oyamazaki-cho, Otokuni-gun, Kyoto

JAPAX INC.
100, Sakato, Takatsu-ku, Kawasaki City,
Kanagawa Pref.

KANZAKI KOKYUKOKI MFG. CO., LTD.
341, Inadera, Amagasaki City, Hyogo Pref.

KARATSU IRON WORKS, LTD.
Marunouchi Bldg., 2-4-1 Marunouchi, Chiyoda-ku,
Tokyo

KASHIFUJI WORKS, LTD.
28, Kamota, Kamitoba, Minami-ku, Kyoto

KATAOKA MACHINE TOOLS MFG. CO., LTD.
7-1, Kyogamine, Miyai-cho, Okazaki City, Aichi Pref.

KEIYO SEIKI CO., LTD.
2-377-3, Katsushika-cho, Funabashi City, Chiba Pref.

KITAGAWA IRON WORKS CO., LTD.
77-1, Moto-machi, Fuchu City, Hiroshima Pref.

KITAGAWA KOGYO CO., LTD.
11-1, Moto-machi, Fuchu City, Hiroshima Pref.

KITAMURA MACHINERY CO., LTD.
1870, Toide-cho, Takaoka City, Toyama Pref.

KOMATSU LTD.
2-3-6, Akasaka, Minato-ku, Tokyo

KONDO MACHINE WORKS, CO., LTD.
91, Nakanotsubo, Hanada-cho, Toyohashi City,
Aichi Pref.

KOTOBUKI INDUSTRY CO., LTD.
2, Minami Matsuda-cho, Higashi Kujo, Minami-ku,
Kyoto

KOYO MACHINE INDUSTRIES CO., LTD.
2-34, Minami Uematsu-cho, Yao City, Osaka

KURASHIKI MACHINERY CO., LTD.
Shinko Bldg., 2-1, Kanda Ta-cho, Chiyoda-ku, Tokyo

MAKINO MILLING MACHINE CO., LTD.
2-3-19, Nakane, Meguro-ku, Tokyo

MARUFUKU MACHINERY WORKS, CO., LTD.
2-1-9, Itachibori, Nishi-ku, Osaka

MATSUURA MACHINERY CORP.
1, Azanuma, Urushihara, Fukui City, Fukui Pref.

MITSUBISHI ELECTRIC CORP.
2-2-3, Marunouchi, Chiyoda-ku, Tokyo

MITSUBISHI HEAVY INDUSTRIES, LTD.
2-5-1, Marunouchi, Chiyoda-ku, Tokyo

MITSUI SEIKI KOGYO CO., LTD.
3-3-7, Nihonbashi Muro-machi, Chuo-ku, Tokyo

MIYANO MACHINERY CO., LTD.
1000, Akiwa, Ueda City, Nagano Pref.

MOTOKUBO MACHINE TOOL WORKS, CO., LTD.
73, Seto-cho, Fukuyama City, Hiroshima Pref.

MURATA MACHINERY, LTD.
3, Minami Ochiai-cho, Kisshoin, Minami-ku, Kyoto

NACHI-FUJIKOSHI CORP.
20, Ishigane, Toyama City, Toyama Pref.

NAKAMURA TOME PRECISION INDUSTRY CO., LTD.
15, Netsuno, Tsurugi-machi, Ishikawa Pref.

NICCO MACHINE TOOL CO., LTD.
1-26-21, Tamagawa, Ota-ku, Tokyo

NIHON DIA INDUSTRY CO., LTD.
1-1-2, Kasuya, Setagaya-ku, Tokyo

NIHON KIKAI SEISAKUSHO CO., LTD.
2-1-1, Matsuba, Nagaoka City, Niigata Pref.

NIIGATA ENGINEERING CO., LTD.
1-4-1, Kasumigaseki, Chiyoda-ku, Tokyo

NIPPEI INDUSTRIAL CO., LTD.
World Trade Center Bldg., 2-4-1,
Hamamatsu-cho, Minato-ku, Tokyo

NISSIN MACHINE WORKS CO., LTD.
300, Aritama Nishi-machi, Hamamatsu
City, Shizuoka Pref.

NOMURA AUTOMATIC LATHE CO.
437, Tanzawa, Okutama-machi,
Nishitama-gun, Tokyo

NOMURA MACHINE TOOL WORKS, LTD.
1-2-37, Nishi Kagaya, Suminoe-ku, Osaka

OGAKI IRON WORKS, CO., LTD.
480, Tsurumi-cho, Ogaki City, Gifu Pref.

OGAWA IRON WORKS, LTD.
472-1, Omachi, Yasufuruichi-machi,
Hiroshima City, Hiroshima Pref.

OHMIYA MACHINERY CO., LTD.
1-404-5, Yoshino Hara-machi, Omiya City,
Saitama Pref.

OKAMOTO MACHINE TOOL WORKS, LTD.
1000, Minowa-cho, Kohoku-ku, Yokohama

OKAMURA IRON WORKS CO., LTD.
3-2-16, Shiroka, Nagaoka City, Niigata Pref.

OKUMA & HOWA MACHINERY LTD.
1111, Maeno, Konan City, Aichi Pref.

OKUMA MACHINERY WORKS, LTD.
1-32, Tsuji-machi, Kita-ku, Nagoya

O.M. LTD.
Umeda Bldg., 1-12-17, Umeda, Kita-ku, Osaka

OOYA MACHINERY WORKS, CO., LTD.
1-8, Tota-cho, Moriguchi City, Osaka

OSAKA KIKO CO., LTD.
8-10, Kita Itami, Itami City, Osaka

RIKEN SEIKO CO., LTD.
Toranomon Bldg., 1-1-12, Toranomon, Minato-ku,
Tokyo

ROKU-ROKU SANGYO, LTD.
4-23-5, Takanawa, Minato-ku, Tokyo

SAKURAI, LTD.
830, Sukenobu-cho, Hamamatsu City, Shizuoka Pref.

SANJO MACHINE WORKS, LTD.
1300, Inokoba Shinden, Sakae-mura, Minami
Kanbara-gun, Niigata Pref.

SANKYO SEIKI MFG. CO., LTD.
5329, Shimo Suwa-cho, Suwa-gun, Nagano Pref.

SANSEI MFG. CO., LTD.
200, Isehara City, Kanagawa Pref.

SANYO MACHINE WORKS, LTD.
1, Oka, Okimura, Nishiharu-cho,
Nishikasugai-gun, Aichi Pref.

SEIBU ELECTRIC MFG. CO., LTD.
868, Kubo, Koga-machi, Kasuya-gun, Fukuoka Pref.

SEIKO SEIKI CO., LTD.
4-3-1, Yashiki, Narashino City, Chiba Pref.

SEIWA IRON WORKS LTD.
4-8-13, Sanwa-cho, Toyonaka City, Osaka

SHIGIYA MACHINERY WORKS, LTD.
6-1, Nishikashima-cho, Fukuyama City, Hiroshima
Pref.

SHIN NIPPON KOKI CO., LTD.
2-44, Kita Kyuhoji-machi, Higashi-ku, Osaka

SHIZUOKA MACHINE TOOL CO., LTD.
9-52, Toyohara-cho, Shizuoka City,
Shizuoka Pref.

SHOUN MACHINE TOOL CO., LTD.
2-1-1, Mikuni, Toyonaka City, Osaka

SUGA MACHINE TOOL CO., LTD.
3-2-11, Sumiyoshi-cho, Anjo City, Aichi Pref.

SUGIMOTO TEKKO, CO., LTD.
2-69, Honjo Nishi, Higashi-Osaka City, Osaka

STAR MFG. CO., LTD.
365, Sena, Shizuoka City, Shizuoka Pref.

TAIYO SEIKI CO., LTD.
3, Funatsu, Kashiwase, Komaki City, Aichi Pref.

TAKISAWA MACHINE TOOL CO., LTD.
983, Natsukawa, Okayama City, Okayama Pref.

TEIJIN SEIKI CO., LTD.
Higobashi Center Bldg., 1-9-1, Edobori, Nishi-ku,
Osaka

TOKYO KIKAI SEISAKUSHO, LTD.
5-26-24, Shiba, Minato-ku, Tokyo

TOSHIBA MACHINE CO., LTD.
4-12-11, Ginza, Chuo-ku, Tokyo

TOYAMA MACHINE WORKS, LTD.
100, Fukuno-machi, Higashi Tonami-gun, Toyama
Pref

TOYODA MACHINE WORKS, LTD.
1-1, Asahi-machi, Kariya City, Aichi Pref.

URAWA MACHINE TOOLS CO., LTD.
10-16-26, Tokiwa, Urawa City, Saitama Pref.

TOYO KOGYO CO., LTD.
3-1, Shinchi, Fuchu-machi, Aki-gun, Hiroshima Pref.

TOYOOKI KOGYO CO., LTD.
45, Kaizan, Hatchi-cho, Okazaki City, Aichi Pref.

TOYO SEIKI CO., LTD.
341, Kofukasaku, Omiya City, Saitama Pref.

TOYO SEIKI KOGYO CO., LTD.
2715, Miyagawa, Chino City, Nagano Pref.

TSUGAMI CORP.
1-18-16, Shinbashi, Minato-ku, Tokyo

TSUNE SEIKI CO., LTD.
852, Takahizuki, Fuchu-machi, Nehi-gun,
Toyama Pref.

URAWA MACHINE TOOLS MFG. CO., LTD.
10-16-26, Tokiwa, Urawa City, Saitama Pref.

WAIDA MFG. LTD.
1-100, Showa-cho, Takayama City, Gifu Pref.

WASINO MACHINE CO., LTD.
1080, Obarimi-Shinden, Komaki City, Aichi Pref.

YAMADA KOKI CO., LTD.
2-5-16, Minami Azabu, Minato-ku, Tokyo

YAMAGE IRON WORKS CO., LTD.
54-2-13, Shimoemori-cho, Fukui City, Fukui Pref.

YAMASAKI GIKEN CO., LTD.
1147, Kanda, Kochi City, Kochi Pref.

YAMAZAKI MACHINERY WORKS, LTD.
1, Norifune, Oguchi-cho, Niwa-gun, Aichi Pref.

YASUDA INDUSTRY CO., LTD.
1160, Hamanaka, Satosho-cho, Asaguchi-gun,
Okayama Pref.

YASKAWA ELECTRIC MFG. CO., LTD.
Ohtemachi Bldg., 1-6-1, Ohtemachi,
Chiyoda-ku, Tokyo

YONEDA TEKKOSHO, LTD.
1-7-10, Toyoshima Minami, Ikeda City, Osaka

YUTAKA SEIMITSU KOGYO, LTD.
592, Kami Ochiai, Yono City, Saitama Pref.

CSO: 4120/74

KEY PRODUCTS OF MACHINE TOOL MANUFACTURERS

Tokyo DIGEST OF JAPANESE INDUSTRY AND TECHNOLOGY in English No 164, 1981 pp 44-78

[Text] Machining Center

Model VMC 7040

Machining Center

Enshu Limited

The VMC-7040 Vertical Machining Center is designed and built on the background of both high technology and excellent workmanship.

Specifications (Mechanical Portion)

Spindle drive motor	DC 3.7 kw constant 55 kw intermittent
Spindle speed range	50 – 3,150 rpm
Table size (working surface)	1,000 x 400 mm
Table T-slots	five 18 wide T-slots every 80 spacings
Table longitudinal travel (X axis)	700 mm
Saddle cross travel (Y axis)	400 mm
Head vertical travel (Z axis)	500 mm
Spindle nose to table top distance	125 – 625 mm
Spindle center to column ways	450 mm
Spindle taper	No. 40
Rapid traverse rate:	
X & Y axes	12,000 mm/min.
Z axis	10,000 mm/min.
Feed range:	
X & Y axes	1 – 2,000 mm/min.
Z axis	1 – 2,000 mm/min.
Maximum weight of workpiece	500 kgf
Machine weight	3,800 kgf
Floor space	2,825 (W) x 2,795 (L) mm
Machine total height	2,640 mm
ATC:	

tool number	25
tool selection	random
took shank	MAS 403-BT 40
max. tool dia. x length	ϕ 75 (ϕ145) mm x 300 mm
max. tool weight	8 kgf

Features

The VMC-7040 Vertical Machining Center is designed for the purpose of getting high productivity and easy handling as well as wide versatility in use, besides it is of high accuracy and reliability. The VMC-7040 has several advanced functions in the standard specifications such as rapid travel speed of 12 m/min., high speed tool change time of 5 seconds, etc., and gives high productivity. The VMC-7040 is easily operated by the unskilled worker thanks to "CRT character display" on the control panel and operation switches arranged systematically on the panel. If trouble should happen, the cause is found immediately by the self diagnosis. The VMC-7040 Vertical Machining Center is most suitable for the facilities for the factory of today.

Machining Capacity

Milling capacity:

(by ϕ 100 mm face mill) 80 Cu. cm/min. in Steel, 100 Cu. cm/min. in Cast Iron.

(by HSS ϕ 20 mm end mill) 40 Cu. cm/min. in Steel, 75 Cu. cm/min. in Cast Iron.

Drilling capacity: ϕ45 in Mild Steel

Accuracy

Positioning accuracy: 0.005 mm/300 mm

Repeatability: ±0.002 mm (each axis)

High Performance

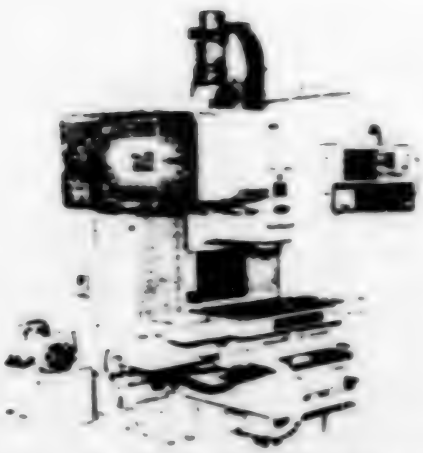
Tool change: 5 seconds

Magazine Capacity: 25 tools

Rapid travel: 12 m/min.

Updatable Design

Draft of Ultra High Precision Spindle



Standard Accessories for ENSHU/FANUC System 6M

Controlled axes: 3 axes (X, Y, and Z). Simultaneously controlled axes: 3 axes. System resolution: 0.001 mm. Keyboard manual data input (MDI). CRT character display. Decimal point programming. Selective absolute/incremental programming within the same block of data. Programming of absolute coordinate zero. Positioning, linear and circular interpolations across different quadrants. Buffer storage. Dwell. Cutter compensation C: +6 digits, G40, G41, G42.

Tool length offset: +6 digits, G45 – G48 (up to 32 sets in total of cutter compensation C and tool length offset values). Manual pulse generator. Dry run. Self diagnostics. Backlash compensation. Single block. Optional block skip. Machine lock. 4-digit sequence number display. Sequence number search. Program number search. Manual/automatic return to reference point. Canned cycle (G80 thru G89). Constant tangential feedrate control. Mirror image: with respect to X and Y axes. Tape reader. Part program storage and editing: 15 m of tape information. Stored pitch error compensation. Rapid traverse override.

Milling Machine–Model 3VN
Machining Center–Model 3VA
Copy Milling Machine–Model 3VT

Hamai Co., Ltd.

- We have the following 3 models:
  CNC Milling Machine, Model 3VN
  CNC Machining Center, Model 3VA
  NC Copy Milling Machine, Model 3VT
  Models 3VA and 3VT have been developed based on Model 3VN, namely 3VA is equipped with ATC and 3VT with Tracer head. Customers can therefore select any one of the above three models according to their purposes.
- Each of Models 3VN and 3VA has a standard spindle head in which contains 2-steps speed change gearing unit. If however high speed operation is required, a high speed type head is available as an optional specification.
- All the three models can be equipped with OILMATIC spindle cooling device so as to make it possible to operate each machine in high speed and in high accuracy.
- Model 3VN is provided with hydraulic unit as the standard execution, which makes it possible to fit pull studs on tools and to clamp and unclamp tools by operating a push button.
- Spindle head of Model 3VT is designed to make quill movable vertically by 100 mm so that easy copying operation can be done.
- For easy maintenance, Model 3VT is equipped with FANUC 330D control and FANUC Tracer head.

Specifications

Specification	CNC Milling Machine 3VN	CNC Machining Center 3VA	NC Copy Milling Machine 3VT
TABLE			
Table surface	1100 mm × 470 mm (43.3" × 18.5")		
Working surface	1100 mm × 400 mm (43.3" × 15.7")		
Max. weight of workpiece	500 kgs (1100 lbs)		
T slot	4 mm - 18 mm (4" - 0.7")		
TRAVEL			
Longitudinal (X)	750 mm (29.5")		
Cross (Y)	400 mm (15.7")		
Vertical (Z)	450 mm (17.7")		
Spindle nose to table top	150 mm – 600 mm (5.9" – 23.6")		50–600mm (2" – 23.6")
Column surface to table top	450 mm (17.7")		
FEED RATE			
Rapid feed (X, Y)	12,000 mm/min (472")		10,000 mm/min (394")
Rapid feed (Z)	10,000 mm/min (394")		
Feed	1 – 3,000 mm/min (0.01 – 120")		1 – 2,000mm/min (0.01 – 80")
Feedback	Pulse Encoder		Resolver
Least input	0.001 (0.0001")		
MOTOR			
Axis Feed (X, Y)	DC 0.8 kw (1 HP)		
Axis Feed (Z)	DC 1.1 kw (1.5 HP)		
Coolant	AC 0.25 kw (1/4 HP)		
Lubricant	AC 4 W (1/200 HP)		
Spindle cooling	AC 0.6 kw (0.8 HP)		
Hydraulic	AC 1.5 kw (2 HP)		
DIMENSION			
Floor space	2600 mm × 2455 mm (102.4" × 96.7")		
Height	2700 mm (106.3")		
DIM			
Machine weight	3600 kgs (8000 lbs)	4300 kgs (9500 lbs)	4100 kgs (9000 lbs)
Power supply	200/220V +10% –15% 3-Phase 50/60 Hz 17 KVA		
FANUC NC Unit	F 6M		F 330D

Head Model

Specification	SG	SB	SGQ
Spindle nose	NT 40 (ISO TAPER 7/24)		
Tooling	MAS-BT40 with Pull Stud (MAS-P40 T-I)		Manual
Tool clamp	Hydraulic		Manual
Spindle speeds	20 – 5000 rpm	100 – 8000 rpm	20 – 5000 rpm
Spindle function	S-4 Digit Direct Programming		Volume change
Spindle motor	AC 5.5 Kw (7.5 HP) 30 min.		
Quill stroke			100 mm
Tracer head			Vertical*
Machine model	3 VN 3 VA	3 VN 3 VA	3 VT

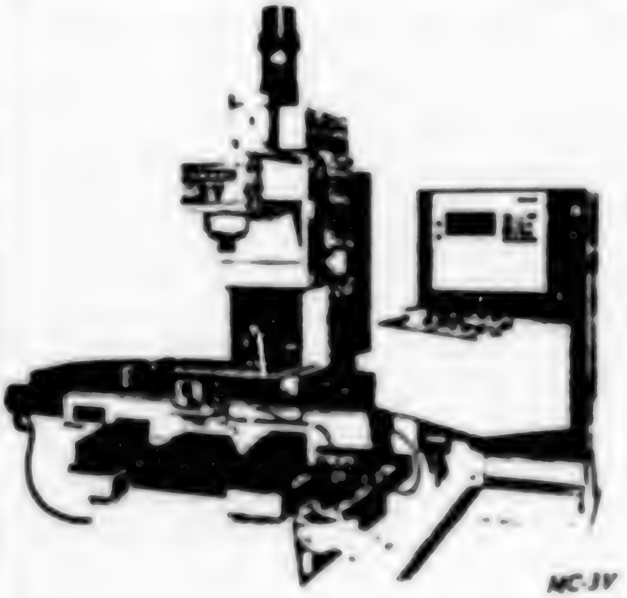
* (FANUC MADE)

Automatic Tool Changer

Capacity of tool	24 tools
Tool selection	Memory random
Tool change time	5 sec
Chip to chip	Approx. 15 sec
Max. tool dia.	80 mm
Max. tool length	300 mm
Max. tool weight	7 kg

Machine Accessories (Standard)
Electric spindle orientation, Trouble diagnosing function, Hydraulic unit, Load meter.
(Options)
Flood coolant system, Spindle cooling device, Splash guard, Screw chip conveyer, Indexing table used with additional axis, Inductosyn feed back.

NC Unit (FANUC 6M) (Standard)
Simultaneous controllable axes: 3 axes, Spindle speed function: S4 digits, direct designation, Fixed cycle, Stored pitch error compensation, Part program storage and editing: 40m (130ft) of tape information, Tape punch interface, Inch/metric conversion, Door interlock.
(Options)
Tape reader with reels, Manual pulse generator, Additional 4th axis, Cutter compensation C, Part program storage and deiting: 40/80/320m (130/264/1056ft) of tape information, Helical interpolation, Character display unit.



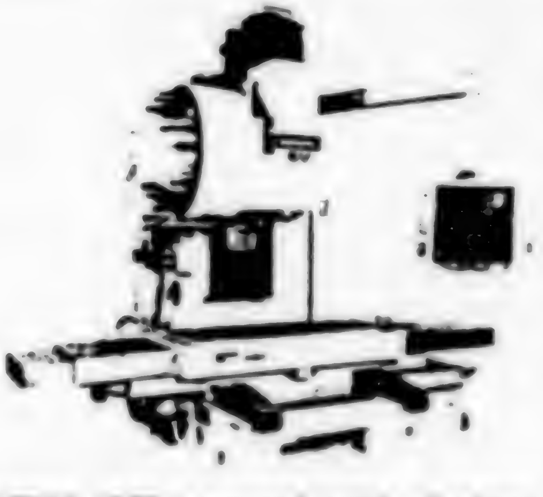
MC-3V

MC Series 5V-6V
Vertical Machining Center

Hamai Co., Ltd.

Features

- Rigid Bed type construction gives the machine the long durability in high accuracy. Also, no overhang exists on all strokes X, Y, Z, and this makes heavy cut in wide range possible.
- Special consideration has been made for the front design in order to make operation easier. Excellent accessibility makes operation efficient.
- Slide surface is provided with cover which protects the machine perfectly from oil and chips. Screw conveyor (6V only) can be supplied optionally.
- The machine has large space table, 1-ton loading capacity and 1-ton Z axis thrust force, enabling to perform machining of large size workpiece and drilling of large diameters.
- Main spindle is driven by a large horse power motor, DC 11 Kw (30 min rating).
  Specially, MC-6V is equipped with 3-step speed change facility, and this makes the machine work for wider speed range from low to high in full power.
- Feed motors for each axis can be fitted on outside machine to ensure easy maintenance. These motors are excellent in heat radiation, therefore these do not affect machining accuracy.
- Main spindle orientation is of electric system. This allows quick movement and trouble-free. Heat pipe is used for main motor so as to keep the motor from overheated.



CONTROL UNIT is mounted outside of column. It is therefore easy to move and fix the unit, and furthermore floor space can be saved to the minimum.

NC UNIT has programming controller, which makes change of machine function and ATC sequence after delivery possible.

OPERATION PANEL is pendant type located in front of the machine. All push buttons, key lamp displays, etc. necessary for machine operation are accommodated in the panel.

Main Specification for MC Series (5V, 6V)

	Specification	Unit	MC-5V	MC-6V
TABLE	Working surface	mm	[illegible]	[illegible]
	Maximum weight of workpiece	kgs	[illegible]	[illegible]
		mm	[illegible]	[illegible]
TRAVEL	Longitudinal travel of table (X)	mm	[illegible]	[illegible]
	Cross travel of column (Y)	mm	[illegible]	[illegible]
	Vertical travel of spindle head (Z)	mm	[illegible]	[illegible]
	Distance from spindle nose to table top	mm	[illegible]	[illegible]
SPINDLE	Spindle nose		[illegible]	[illegible]
	Spindle speeds	rpm	[illegible]	[illegible]
	Distance from spindle center to column surface	mm	[illegible]	[illegible]
FEED RATE	Rapid feed	mm/min	[illegible]	[illegible]
	Feed	mm/min	[illegible]	[illegible]
	[illegible]		[illegible]	[illegible]
	Least input increment	mm	[illegible]	[illegible]
MOTOR	Spindle motor	kw	[illegible]	[illegible]
	Axis feed	kw	[illegible]	[illegible]
WEIGHT		kgs	[illegible]	[illegible]
AUTOMATIC TOOL CHANGER	Capacity of tool magazine	tools	20	20
	Tool selection		Random selection	Random selection
	Tool change time	sec	[illegible]	[illegible]

Machine Accessories (Standard)

Electric spindle orientation, Trouble diagnosing function, Fan cooler for main spindle, Hydraulic unit, Load meter.

(Options)

Flood coolant system, Spindle cooling device, Splash guard, Screw chip conveyer, Magazine for 24 tools (5V only), Indexing table used with additional axis, Inductosyn feed back.

NC Unit (FANUC 6M) (Standard)

Simultaneous controllable axes: 3 axes, Spindle speed function: S4 digits, direct designation, Fixed Cycle (G73, G74, G76, G80–89). Stored pitch error compensation, Part program storage and editing: 15m (49ft) of tape information, Tape punch interface, Inch/metric conversion, Door interlock.

(Options)

Tape reader with reels, Manual pulse generator, Additional 4th axis, Cutter compensation C, Part program storage and editing: 40/80/320m (130/264/1056ft) of tape information, Helical interpolation, Character display unit.

MC-50V, 70V, 80V
Vertical Machining Center

Hamai Co., Ltd.

Column Feed Design:

These new Machining Centers have been developed after years of experience in manufacturing a range of production milling machines supplied to the automobile industries. The column feed construciton is the most advanced engineering concept in machining center design providing for superior machine balance and exceptional rigidity resulting in high precision performance over extended periods of time.

Workpiece Loading and Unloading:

The generously proportioned travel movements in all axes in addition to the large table area will cut loading and unloading time to a minimum. The flat design of the front surface of the table bed will allow for maximum crane access to the machine loading and unloading area.

Massive Slideway Surface:

All machine slideway surfaces provide sufficient bearing width. This massive construction insures the accommodation of heavy workpieces and heavy cutting loads, without sacrificing precision. The Y and Z axis slideway surfaces are manufactured of hardened and ground steel plate and the X axis surface is of hardened and ground meehanite casting. Smooth and continuous no-bind motion of sliding members is assured through the use of Turcite B where metal to metal contact might normally be an impediment to member movement.

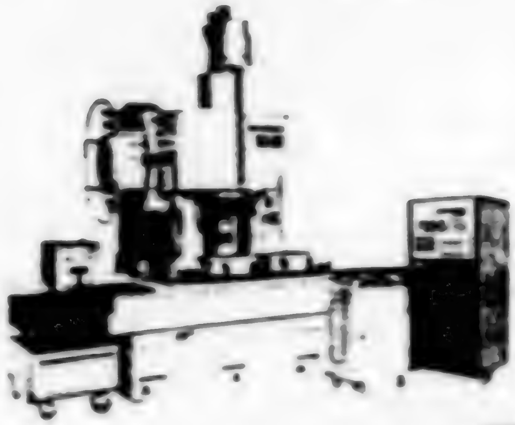
Slideway Lubrication System:

Hamai engineers have designed an exceptionally reliable piston-type distributor using steel conduit piping to provide for fail-safe slideway lubrication. In addition, they have installed a safety alarm lamp to alert the operator in the remote event that there is a lubrication malfunction.

Automatic Tool Changer:

The 20 tool automatic tool changer provides for random tool selection and is mounted on the side of the machine precluding the possibility of interference in the machine operation. The tool changing technique used is extremely efficient and tool change time is rated at 5 sec. Tool pots will accommodate maximum diameters of 150 mm (6"), a maximum tool length of 350mm (13.8") and maximum tool weight of 15 kgs (33lbs).

Rugged Spindle Construction:



MC-50V

Each machine is provided with a spindle having sufficient diameter, which is supported by a doule row cylindrical roller bearing in addition to a double row angular thrust bearing. The massive proportioned spindle coupled with the support bearing positioning, insures maximum machining efficiency and high precision under the most adverse cutting conditions.

Spindle Head Lubrication and Cooling:

An outside forced lubrication system is used in conjunction with a cooling fan to maintain the spindle head at a constant temperature of +7°C (44.6°F). For special continued cutting at high speeds Hamai offers an optional unit to provide constant spindle head temperature at ±2°C (35.8°F). This feature will provide for continued high speed accuracy without the risk of thermal distortion.

Hamai Co., Ltd. manufactures all types of vertical machining centers ranging from small to large sized ones.

Machine Accessories (Standard)

Trouble diagnosing function, Fan cooler for main spindle,

Machine Specification for MC Series (50V, 70V, 80V)

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TABLE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]
TRAVEL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SPINDLE	[illegible]		[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FEED RATE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]		[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MOTOR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WEIGHT		[illegible]	[illegible]	[illegible]	[illegible]
AUTOMATIC TOOL CHANGER	[illegible]	[illegible]	20	20	20
	[illegible]		Random selection	Random selection	Random selection
	[illegible]	[illegible]	5	5	5

Hydraulic unit, Load meter.
(Options)
Flood coolant system, Spindle cooling device, Splash guard, Screw chip conveyer, Magazine for 24 tools, Long tables & extension of table travel, Indexing table used with additional axis. Inductosyn feed back, Automatic workpiece changer.

NC Unit (FANUC 6M) (Standard)
Simultaneous controllable axes: 3 axes, Spindle speed function: S4 digits, direct designation, Fixed cycle (G73, G74, G76, G80–89), Feed function: F-1 digit feed rate, Stored pitch error compensation, Tape reader with reels, Part program storage and editing: 40m(130ft) of tape information, Tape punch interface, Manual pulse generator, Inch/metric conversion, Door interlock
(Options)
Additional 4th axis, Cutter compensation C, Part program storage and deiting: 80/320m (264/1056ft) of tape information, Helical interpolation, Character display unit.

MACCMATIC-610V

Vertical Machining Center
NC Built-in Type

Hitachi Seiko, Ltd.

Features

Easy Access to the Table

Bed type, column crosswise travelling design ensures excellent maneuverability and easy access to the machine. Because of no protrusion in front of the table, the workpiece can be mounted and removed very easily: and centering is facilitated.

Pendent Type Concentrated Operating Panel

All the controls are put on the pendent-type operating panel and are arranged properly from the viewpoint of human engineering.

One Travelling Unit in Each Axis

The table moves longitudinally, the column crosswise and spindle head in vertical direction. During travel in crosswise and vertical direction no weight is displaced and the friction conditions on the ways do not change. Thus, high accuracy can be kept for long time. Positioning accuracy is ± 0.010/300mm. (± 0.0004/12")

Micro-Computer Processed Interface

Sequence controllers are integrated into large-size IC design PCB. The use of micro-computer for machine interface enables electrical circuit without conventional contacts, thereby establishing reliability for a long period of time and enhancing performance.

Specifications

TABLE AND RANGE

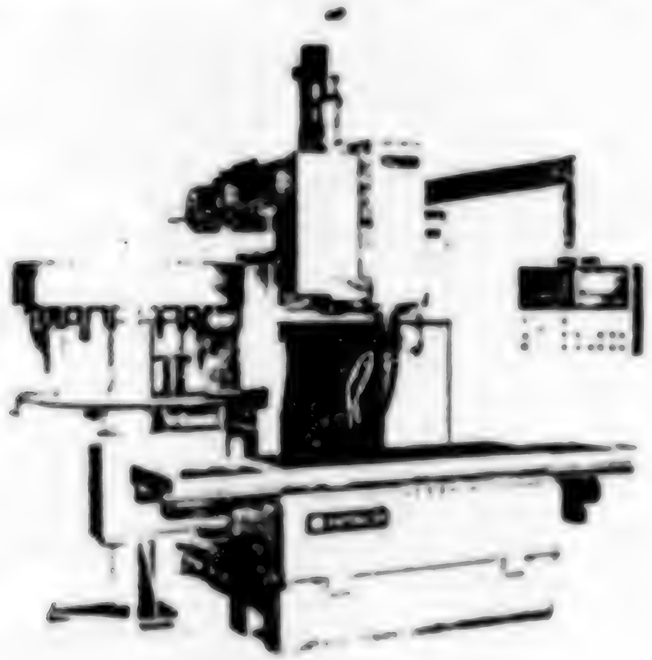
Working surface	1,400 x 550 mm
X axis travel	1,000 mm
Y axis travel	600 mm
Z axis travel	550 mm
Table to spindle end	200 – 750 mm
Max. loading on table	1,000 kg

SPINDLE

Main motor	11 KWAC (30 min rating) 15 HP
Taper	NT No. 45
Spindle speeds	32 – 4,000 rpm

AUTOMATIC TOOL CHANGER

Number of tools	30 tools
Tool shank	CT Frange No. 45
Selection	Random
Machine weight (w/out N/C)	7,500 kg



Model MH-400

CNC Ram Type Horizontal Machining Center

Kurashiki Machinery Co., Ltd.

Spindle Operation

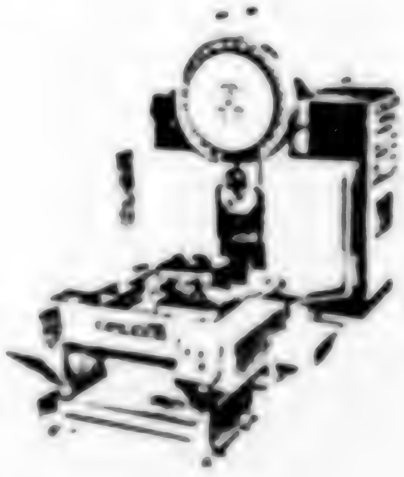
- Machine Body: The built-in control unit adds convensence and neat appearance to the machine.
- Ram Type Construction: The ram type spindle axis increases rigidity and makes heavier milling operations possible.
- Spindle Speed: Speed can be selected by one RPM increment throughout full range.
- Auto Pallet Changer: The Auto Pallet Changer is compact, accurate and simple to operate.

High Reliability

- Adoption of IC: The reliability of the NC unit has been increased by adopting IC in the sequence relay circuit.
- Precise Table Index: The curvic coupling type indexing system (5 degree increments) adds precision and reliability.
- Automatic Tool Changer: This ATC has no change arm but is simply constructed for rapid changes. (Change time 4.5 secs. for consecutive tools).

Good Productivity

- Check Function: Down time can be minimized by use of the input-output check function.
- Tool Selection: Tools can be selected at random by means of the address T and 2 digits.
- Tool Storage: The machine has a 24 station automatic tool changer.
- Fast Reverse Spindle: Tapping time is minimized with the quick exchange function. (Forward, Stop, and Spindle reverse)



Specifications

Stroke

Table longitudinal travel (X)	600 mm
Ram vertical travel (Y)	400 mm
Distance between spindle center and table surface	50 – 450 mm
Ram travel (Z)	300 mm
Distance between spindle end and table center	200 – 500 mm

Model KV-1000

CNC Vertical Machining Center

Kurashiki Machinery Co., Ltd.

- Minimum Space Requirements by the Built-in Control Unit

The hydraulic unit and the electrical equipment consisting of the NC equipment, electrical control panel, etc. are installed on the side and the rear of the machine to attain the built-in control unit, so that the required floor space has been minimized to make it easy to move and install.

- Pendant Control Designed for Operation Convenience and Efficiency

The portions of the equipment related to the operation of the machinery and the NC operation, such as push buttons and indication lamps are concentrated on a pendant control panel so that the most of all operations can be conducted from the front of the machine and the operator does not need to move around here and there, thereby they can make it very efficient in operation.

- A Wide Table and Large Depth of Machining Area

In comparison with other similar sized machining centers, the table width and the depth of the machining area are larger, so being more suitable for the machining of mould.

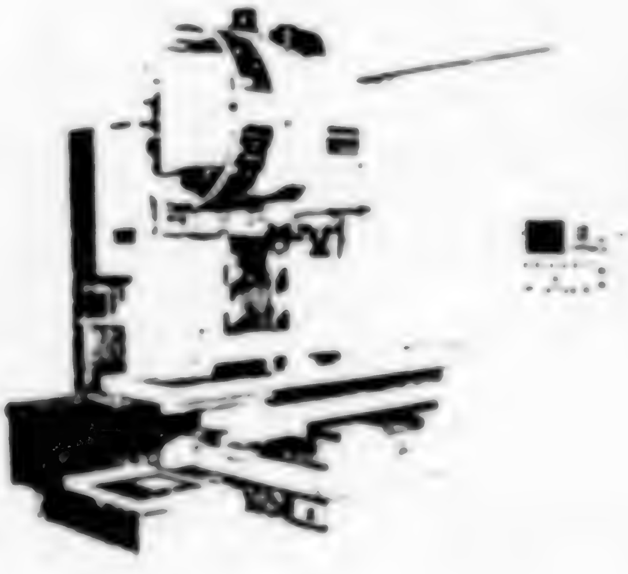
- Superior Performance of the Spindle

The maximum revolutions of the spindle for the KV-700 at 5000 rpm and the KV-1000 at 3100 rpm are quite a lot, making possible a very high degree of efficiency and precision machining. These characteristics become most apparent in the machining of aluminum material.

Specifications

Table

Working surface	1400 x 550 mm
Longitudinal travel (X)	1050 mm
Cross travel (Y)	550 mm



Machining Center
Model MC65

Makino Milling Machine Co., Ltd.

The MC65 is designed to deliver utmost productivity and peak accuracy at the same time.

Makino invites you to take a long, hard look at the MC65 Horizontal Machining Center and a long, hard look at the many advantages it can bring to your operations – including a cost efficient initial investment. A product of Makino's proven metalworking technology, the MC65 is right on target in machining the parts size range turned out most frequently, in upgrading productivity and helping you to realize an unmanned and flexible manufacturing system.

- With high power for versatile machining
  - Extended nose 100 mm dia spindle is powered by a heavy-duty 7.5kW DC motor
  - Spindle speed range from 10 to 4000 rpm is programmed in actual rpm in one rpm increments.
  - Simple two step gear change protects it from any thermal deflection and guarantees stable milling and boring operation even in the low speed range.

- With simple and fast tool changes
  - Microcomputer controlled random pot coding assures tool selection from magazine in the shortest bi-directional tool path.
  - The magazine can store 30 tools of max. size ϕ135 x 400 mm and 12 kg tool capacity.
  - ATC time: tool-to-tool 3 sec.
    metal-to-metal 10 sec.

- With a large index table capacity
  - A 500 mm square, pallet type work table provides index positions. It rotates bi-directionally in 8 sec. for 90° indexing and 11 sec. for 180° indexing.
  - Edge locators facilitate easy and accurate location of fixtures on T-slotted work table.
  - Handles workpieces and fixtures having a combined weight of up to 700 kg and a size of 620 mm square or 810 mm diameter.
  - Large diameter 420 mm curvic coupling indexer guarantees ±3 sec. indexing accuracy and 4600 kg of clamping force assures stable machining.

- With a self-contained pallet changer as standard
  - Uniquely designed, the integral pallet changer assures faster pallet change and eliminates any extra drive source.
  - Any chip or dust is splashed during pallet changing, thereby the positioning accuracy can be maintained within ±0.01 mm.
  - Pallet changing time is approx. 35 sec.

Specifications

Size of table	500 x 500 mm (20" x 20")
Range of movement (X x Y x Z)	630 x 525 x 500 mm (25" x 20-3/4" x 20")
Spindle center to table top	50 – 550 mm (3" – 22-3/4")
Spindle nose to table center	150 – 650 mm (6" – 26")
Spindle nose/speed/step	ISO. No. 50/10 – 4000 rpm/ stepless
Min. resolution	0.001 mm (±0.00004")
Cutting feed/Rapid traverse	(0.04 – 95 ipm/480 ipm) 0.04 – 95 ipm/480 ipm)
Spindle drive	7.5 kW, DC (10 HP)
Number of tools	30 (4, 60)
Tool shank	SK shank or MAS shank or V flange
Max. tool dia & length	ϕ135 x 400 mm (ϕ5-5/16" x 16")
Machine weight	7500 kg (16500 lbs)

H-Series
Horizontal Die & Mold Machine

Makino Milling Machine Co., Ltd.

Another new development emanates from Makino research

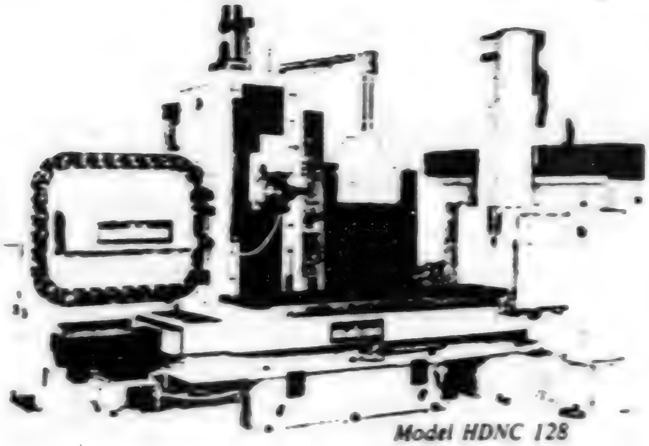
The H-Series Horizontal Die & Mold Machine. This new series realizes high speed, high accuracy machining and fully automates die and mold machining through Makino's long years of cutting experience combined with modern machining center techniques.

- The new horizontal series promotes efficiency of unmanned operations.

  The horizontal machining center construction with automatic tool changer, programmable command controller and complementing automatic equipment realizes completely unmanned die and mold machining.
- Self-contained NC saves floor space.

  The NC unit is mounted on the bed of the main body and the built-in hydraulic unit offer a substantial saving of floor space.
- Excellent accessibility and easy operations.

  The design of the series enables smooth interaction of electro-mechanical systems to minimize human operations. The protruding spindle nose and centralized control panel installed near the spindle simplify centering of the work and allow unrestricted access to the workpiece.



Model HDNC 128

- Semi-floating slideways achieve high-precision machining of heavy work.

  Newly developed pneumatic Semi-Floating Slides are unaffected by the load and cutting force, and permit long-life smooth movements for precision machining.
- ATC and ASC facilities fully automatic copy milling.

  The automatic tool changer (ATC) and automatic stylus changer (ASC) and programmable command controller permit around-the-clock automatic copy milling operations.
- Separated tracing unit realizes high copying accuracy.

  Since the tracing unit is separately installed, high copying accuracy is maintained without influence of vibration during heavy cutting.

Machine Body

Item		Model		H-128	H-178
Table	Length x Width	HNC (A)	mm (inch)	1500 x 750 (59-1/16 x 29-1/2)	1900 x 750 (74-13/16 x 29-1/2)
		HD-(A), HDNC-(A) (including model table)	mm (inch)	2750 x 750 (108-1/4 x 29-1/2)	3600 x 750 (141-3/4 x 29-1/2)
	T-slot width x number		mm (inch)	22H8 x 5 (13/16H8 x 5)	22H8 x 5 (13/16H8 x 5)
Range of movement	Table longitudinal movement (X axis)		mm (inch)	1250 (49-3/16)	1700 (66-15/16)
	Spindle vertical movement (Y axis)		mm (inch)	800 (31-1/2)	800 (31-1/2)
	Column cross movement (Z axis)		mm (inch)	550 (21-5/8)	550 (21-5/8)
	Spindle center to table top		mm (inch)	50 ~ 850 (2.0 ~ 33-1/2)	20 ~ 820 (3/4 ~ 32-1/4)
	Spindle nose to table center		mm (inch)	50 ~ 600 (2.0 ~ 23-5/8)	50 ~ 600 (2.0 ~ 23-5/8)
	Copying range (X x Y x Z)		mm (inch)	1250 x 800 x 550 (49-3/16 x 31-1/2 x 21-5/8)	1700 x 800 x 550 (66-15/16 x 31-1/2 x 21-5/8)
Feed rate	Cutting feed	HNC (A)	mm/min (ipm)	0.1 ~ 4000 (0.01 ~ 157.4)	0.1 ~ 4000 (0.01 ~ 157.4)
		HD-(A), HDNC (A)	mm/min (ipm)	10 ~ 2000 (0.4 ~ 78)	10 ~ 2000 (0.4 ~ 78)
	Rapid traverse	HNC (A)	mm/min (ipm)	10000 (400)	10000 (400)
		HD-(A), HDNC (A)	mm/min (ipm)	6000 (236)	6000 (236)
	Copying speed		mm/min (ipm)	10 ~ 2000 (0.4 ~ 78)	10 ~ 2000 (0.4 ~ 78)
Spindle	Spindle nose			ISO No. 50	ISO No. 50
	Spindle speed (steps)		rpm	10 ~ 4000 (1 rpm each stepless)	10 ~ 4000 (1 rpm each stepless)
	Spindle drive motor		kW (HP)	DC 11/7.5 (15/10)	DC 11/7.5 (15/10)
Max. weight on table			kg (lbs)	5000 (11000)	7000 (15400)
Tracer head adjustment	Table top to tracer head		mm (inch)	200 ~ 850 (8 ~ 33-1/2)	200 ~ 850 (8 ~ 33-1/2)
	Spindle center to tracer head center		mm (inch)	1550 (61)	2050 (80-11/16)
	Tracer head longitudinal movement		mm (inch)	100 (4.0)	100 (4.0)
Machine weight	HNC (A) (including control unit, ATC adds 700 kg (1540 lbs))		kg (lbs)	7500 (16500)	11500 (25300)
	HD-(A), HDNC-(A) (including control unit, ATC adds 700 kg (1540 lbs))		kg (lbs)	9500 (20900)	13000 (28600)

MCH-800
Horizontal Machining Center

Osaka Kiko Co., Ltd.

Features

- Rugged construction
- Full simultaneous capability on three axes
- Independent DC spindle drive with speeds variable from 30 to 3,000 rpm.
- Large, precise tool holders (NS #50 taper)
- Equipped with latest CNC control
- Automatic tool changer with 30-tool capacity (50-tool capacity optional)

Tool Magazine

30 tools are combined in one with the automatic indexing magazine accommodating 30 tools. Starting and stopping are performed at a reduced speed to prevent vibrations and shocks that could have a bad effect on machining accuracy.

Combination Table

The combination table can be used as either a circular indexing table or a plane table. Workpieces of almost any configuration can be machined on this table.

Automatic Tool Changer

With grips at both ends, the swing arm holds and changes tools quickly. The tool holder remains securely locked while the tool changer arm moves, ensuring proper operation.

Coolant Reservoir

The large capacity coolant reservoir is in a separate location to eliminate adverse thermal effects. A special design has been employed to allow for an ample amount of coolant to reach the tools regardless of type or length.

Symmetrical Double Column

The box-type bed and the frame with thermally symmetrical double columns can withstand heavy loads and provide outstanding machining accuracy under the most rigorous operating conditions.

Microcomputer CPU Sequencer

Microcomputer and semiconductor technology has been incorporated to provide highly reliable control of the entire machine. The maintenance board enables the rapid identification of mechanical problems, speeding up maintenance operations.

DC 20/15HP (15/11KW) Spindle Drive (MCH-800)

The speed of the DC spindle motor is variable over a wide range. Operation under optimum conditions is ensured by tooling in the large-bore spindle (4 inches, 100mm diameter) which enables everything from heavy-duty cutting at low speeds to high-speed machining. To maintain a high degree of accuracy during use, an oil jacket is provided for heat dissipation in the spindle area.

Fine Indexing Table (Optional)

The fine indexing table driven by a DC servo motor turns in either a clockwise or a counterclockwise direction and can be indexed in a total of 360 positions.

Specifications

Cutting Area (X x Y x Z): 1200 x 1020 x 815mm (Single table); 2000 x 1020 x 815mm (Combination table).

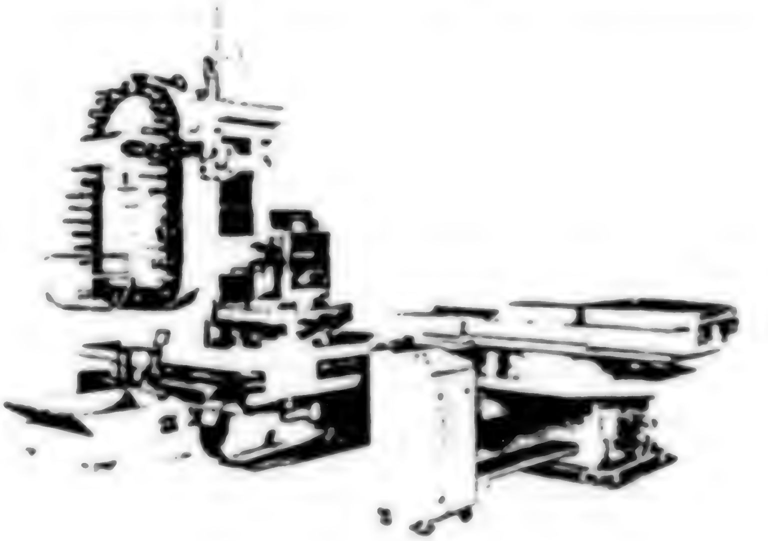
Table dimensions: Index Table – 800mm sq. Combination table – 800 sq. x 2200mm (Combination table).

Index table dividing degrees: Each 5 degrees (optional 1 degree).

Carrying capacity: Only index table – 1500 kgs. Total – 2000 kgs (Combination table).

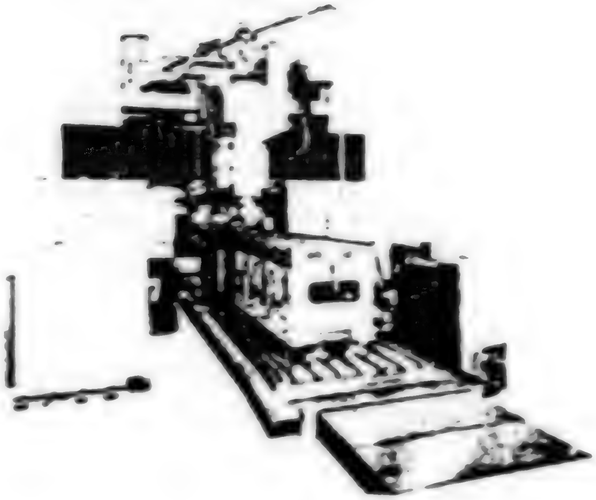
Indexing time: 6 sec./45 degrees, 8 sec./90 degrees, 11 sec./180 degrees.

Travels: Longitudinal travel (X) – 1200mm (Single table); 2000mm (Combination table). Head vertical travel (Y) – 1020mm. Saddle cross travel (Z) – 815mm. Spindle center to table – 100 to 1120mm. Table center to spindle – 250 to 1065mm.



Multi-Center
HF-3

Shin Nippon Koki Co., Ltd.



A five face multi-function center with outstanding all-round machining capacity.
Equipped with a variety of energy-saving devices.

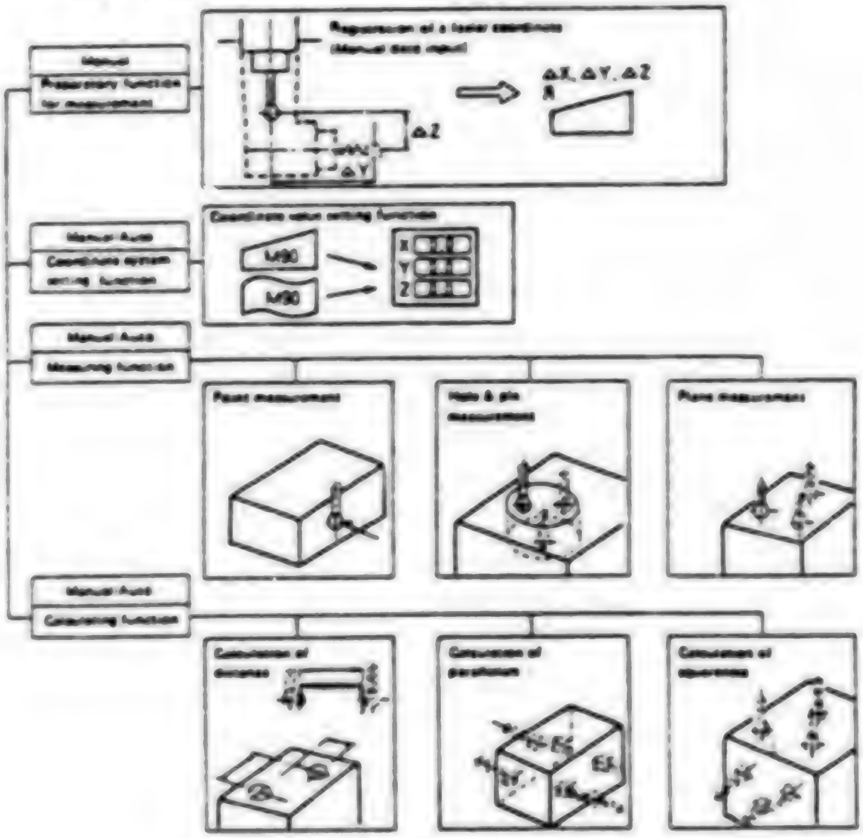
Main Features

- An Automatic Attachment Changer for automatic five-face machining.
- Measurement function for increased quality control.
- A large Automatic Work Changer for increased productivity.
- SNK's "THERCOM" thermal displacement compensator, for high machining accuracy.
- A variety of safety features essential for unmanned operation including tool wear and breakage detector.

Specifications for HF-3

Distance between columns	2,100 mm
Table working surface	1,500 mm x 3,000 mm
Pallet size	1,400 mm x 2,800 mm
Distance from pallet surface to spindle end	1,600 mm
Loading capacity on table [pallet]	10,000 kg [7,000 kg]
Table travel (X)	6,200 mm
Spindle head travel (Y)	2,700 mm
Vertical travel of ram (Z)	750 mm
Crossrail elevating travel (W)	1,050 mm
Rapid feed (X, Y)	9,600 mm/min
Rapid feed (Z)	3,000 mm/min
Rapid feed (W)	4,000 mm/min
Cutting feed	5 – 3,000 mm/min
Spindle speed	30 – 2,000 rpm
Spindle diameter	120 mm
Spindle nose taper	AST No. 50
Spindle drive motor	DC 22 kw

Measuring System



Millmaster B-3V

Vertical Machining Center with Automatic Tool Changer

Shizuoka Machine Tool Co., Ltd.

Shizuoka Machining Center B-3V was developed for the customers who demand close tolerances with both high speed cutting and low speed heavy-duty cutting. The practical machining center enables amazing productivity plus precision machining.

- High Efficiency Machining

  The husky spindle head for DC 5HP (3.7kw) motor assembled with precision components employs efficient heat exchanger to reduce heat generation for stabilized precision machining. The spindle can be driven direct by S-4 digit function, and speed can be changed variably. The most appropriate cutting condition can be selected for various work materials in a range of 10 – 3600 rpm (10 – 4500 rpm). Available with an automatic tool changer holding 20 tools for milling, boring, drilling and tapping.
- High Precision and Years of Dependability

  The rugged box type substructure of bed and column, frame hardened and ground slide ways, automatic lubrication, and precision ground ball screws with pre-loaded double nuts for all axes to minimize backlash and eliminate stick-slip motion. They combine for precision machining and positioning, and furthermore trouble free life.
- Large Machining Area

  The wide table movement up to 700 mm x 380 mm and the large depth from spindle center to column surface for 420 mm are the next larger size machine's.
- Economical Machining Center

  The compact and simple pneumatic tool change mechanism insures reliable tool change and ease of maintenance, and greatly reduces machine's down time.

Specifications

TABLE – Working surface: 1100 mm x 330 mm. T-slot: 16 mm x 3 x 60 mm. Loading capacity: 300 kg. Travel: Longit. (X), 700 mm; Cross (Y), 400 mm; Vertical (Z), 400 mm.

SPINDLE – Nose taper: ISO No. 40. Speed range: 10 – 3600 rpm (10 – 4500 rpm). Spindle drive motor: 5HP DC motor (30 min).

FEED – Feed rate: 0 – [illegible]000 mm/min. Rapid traverse X, Y, 6000 mm/min; Z, 3000 mm/min. Feed motor: Gettys-Fanuc DC servo motor; X, Y, Model 0; Z, Model 5.

ACCURACY – Positioning: 0.025 mm/300 mm. Repeatability: +0.005 mm.

AUTOMATIC TOOL CHANGER – Tool storage capacity: 20 tools (BT-40). Tool change system: Random. Max. tool weight: 5 kg. Max. tool diameter: 100 mm. Nominal diameter: 75 mm. Max. tool length: 300 mm.

WEIGHT (less NC) – 2200 kg.

Millmaster B-10V

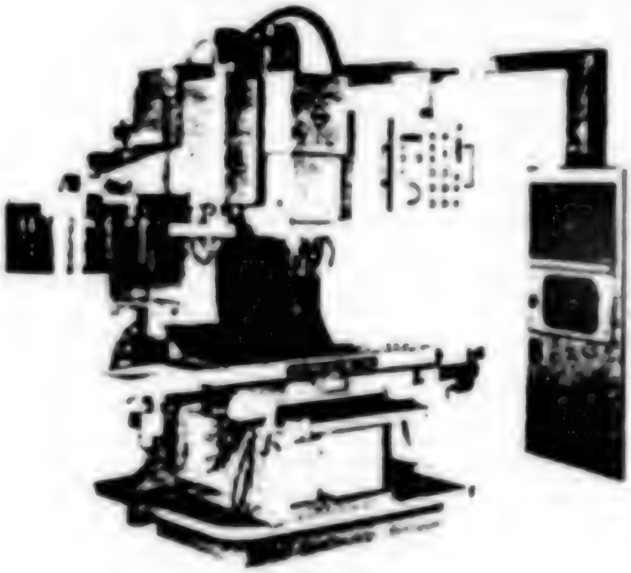
Vertical Machining Center with Automatic Tool Changer

Shizuoka Machine Tool Co., Ltd.

Machining Center B-10V with Automatic Tool Changer is the answer to the customer for its high productivity and precision machining accuracy with rugged bed type construction.

- Heavy Duty 10 HP DC Motor Drive Spindle

  Incorporated with four angular contact bearings for spindle . . . . well lubricated and properly pre-loaded, and with heat exchanger built on headstock, this minimizes the heat generation for stabilized precision machining. Best work condition can be selected for the various kinds of tools and work materials in the wide range of speed, 10 – 3150 rpm, by means of 10 HP DC main spindle motor.
- Wide Slide Way and Accurate Positioning



Millmaster B-3V

All the slide ways are solid casted, hardened, and ground, and the counter-part of each way is plated with TURCUITE B for smooth movement of head, table and saddle. They maintain the machine rigidity, stability and high precision of machining accuracy.

- Rugged Substructure

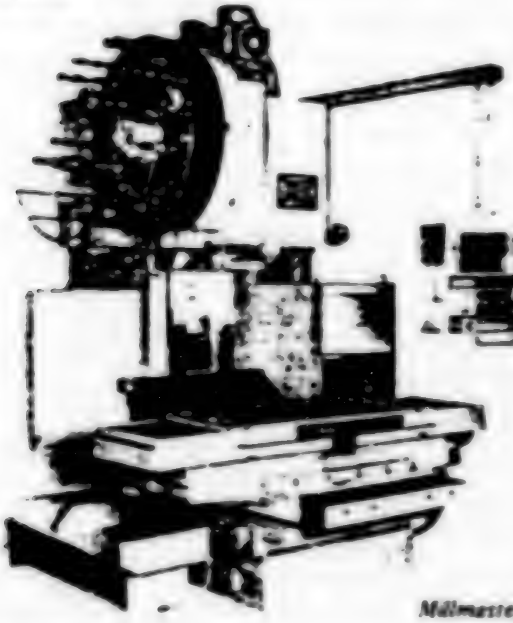
  The rugged box type substructure of machine ensures fine machining surface even for heavy cutting at low spindle speed.

- Pendant Control Panel

  All the switches and digital display are centralized on the pendant panel which swings to the most convenient operating position. Operator, therefore, can set up faster and easier.

- Reliable ATC.

  The tool magazine is designed to have 16 tools, max. weight of 10 kg, max. diameter of 140 mm, max. length of 400 mm. The characteristic pneumatic changer arm (double) ensures stable tool change without fault.



Millmaster B-10V

Specifications

TABLE – Working surface: 1200 mm x 500 mm. T-slot: 18 mm x 5 x 100 mm. Loading capacity: 1000 kg. Travel: Longit., 1000 mm; Cross, 500 mm; Vertical, 500 mm.

SPINDLE – Nose taper: ISO No. 45. Speed range: 50/60 Hz 10 – 3150 rpm. Spindle drive motor: 10 HP DC motor (30 min).

FEED – Feed rate: 5 – 3000 mm/min. Rapid traverse (X, Y, Z): 10000 mm/min. Feed motor (X, Y, Z): Gettys-Fanuc DC servo motor Model 10.

ACCURACY – Positioning: 0.025 mm/300 mm. Repeatability: ±0.005 mm.

AUTOMATIC TOOL CHANGER – Tool storage capacity: 24 tools (CT-45). Tool change system: Random. Max. tool weight: 10 kg. Max. tool diameter: 140 mm. Nominal diameter: 115 mm. Max. tool length: 400 mm. Arm type: Double arm.

WEIGHT (less NC): 6100 kg

Model FHN80T

Horizontal Spindle Machining Center

Toyoda Machine Works, Ltd.

– High Total Productivity Endeavored by Latest Automatic Functions. Efficiency up per One Machine and Reduction of Operator's Burden (Possibility of Being Handled Plural Machines by One Operator).

- Application of automatic functions

  Higher productivity is assured by adopting such various automatic functions as automatic alignment, gap elimination and tool breakage detection.

- Contribution to easier operation

  Tool Service-life is observed automatically by monitoring function. Handy loading/unloading of tools are attainable due to the tool magazine mounted on machine side. Loading/unloading of component is easier due to the table height as low as 900 mm (35.4").

- Improvement in higher reliability and easier maintenance

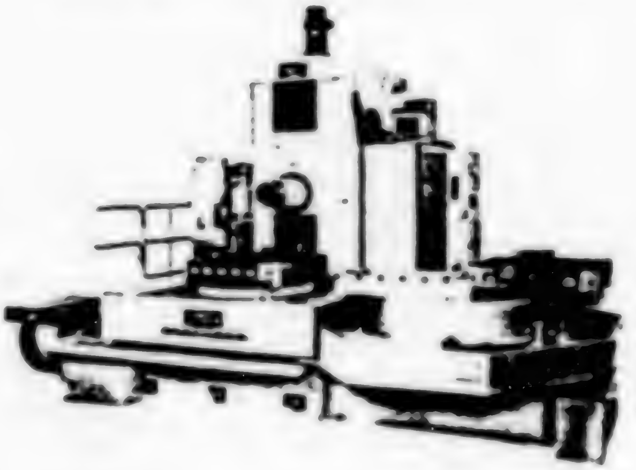
  As troubles are exactly found by monitoring function, machine down-time is substantially reduced. Programmable universal sequence controller TOYOPUC can be used for higher reliability and easier maintenance.

- Spindle speed, 20 to 3,600 rpm (4-digit, S-function)

  Wide range of spindle speed (20 thru 3,600 rpm) allows wide variety of machining conditions from low-speed heavy cutting to high-speed cutting.

- Tool magazine capable of storing various tools

  Large diameter tool storage zone enables the capacity of tool magazine maximum.



Specifications

Rotary index table	800 x 800 mm (31.5" x 31.5")
Table index incremental angle	5 degree (automatic)
Table, lateral travel (X)	1,000 mm (39.4")
Spindle head, vertical travel (Y)	900 mm (35.4")
Upright column, cross travel (Z)	800mm (31.5")
Rapid feedrate	10,000 mm/min (394 ipm)
Spindle speed, infinitely variable	20 – 3,600 rpm
Spindle drive motor	DC 11 kW (15 HP)

Automatic Tool Changer

Nos. of stored tools	32
Tool selection	Ramdon selection
Tool size (diameter x length)	Small diameter zone: 110 x 400 mm (4.3" x 15.7") Large diameter zone: 165 x 400 mm (6.5" x 15.7")
Tool weight	Max. 20 kg (44 lbs)

Model FVN50, 50A
Vertical Spindle Machining Center

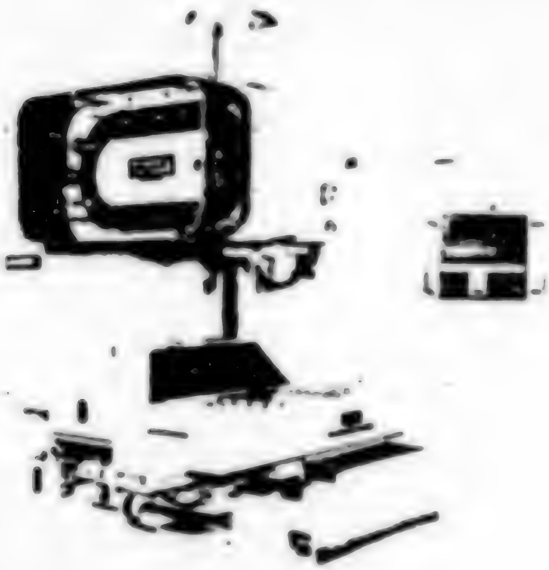
Toyoda Machine Works, Ltd.

- Increased Workability by Total Designing for Saving Costs, Manpower and Space.
- High Total Productivity Endeabored by Latest Automatic Functions.

- Single unit
  NC unit, electrical control panel and hydraulic power unit are mounted onto a machine body, and this reduces floor space to 8 m^2 (86 sq. ft. excluding maintenance space), facilitating carriage and installation of machine.

- Easy operation
  A pendant type operation panel houses all control switches and buttons, and allows operator to manage whole operation of the machine, watching the component at the front of the machine.

- High spindle capacity
  Spindle design bears wide machining range from low speed heavy duty to high speed cutting. Any revolution between 20 and 3,150 rpm are infinitely selectable by means of direct S-coded 4-digit command. A large flywheel gear shows strong and stable action in interrupted cutting or heavy duty cutting.



- Efficient workability
  Low table height of 80 mm (31.5") from the floor provides easy accessibility from the front, and brings easy loading/unloading of components and fixture.

- Application of automatic functions
  Higher productivity is assured by adopting such various automatic functions as automatic alignment, gap elimination and tool breakage detection.

Specifications

Work table	900 x 630 mm (354.4" x 24.8")...FVN50 1,400 x 630 mm (55.1" x 24.8")...FVN50A
Table lateral travel (X)	800 mm (31.5") 1,250 mm (49.2")...FVN50A
Saddle cross travel (Y)	560 mm (22.0")
Spindle head vertical travel (Z)	560 mm (22.0")
Rapid feedrate	10,000 mm/min (394 ipm)
Spindle speed (infinitely variable)	20 – 3,150 rpm
Spindle drive motor	DC 7.5 kW (DC 10 HP) for 30 min. running and DC 5.5 kW (DC 7.5 HP) for continuous running

Automatic Tool Changer

Nos. of the stored tools	20 pcs.
Tool selection	Random selection
Tool size (diameter x length)	120 x 400 mm (4.7" x 15.7") Larger tool available under certain condition
Tool weight	15 kg (33 lbs)

UB-75
Vertical Machining Center

Urawa Machine Tools Mfg. Co., Ltd.

Construction

The machine is constructed of cast iron castings comprising of a one piece base, 2 vertical columns and a cross beam, which supports the main spindle saddle. The steel guarding system completely surrounds the working area with front access thro' two hinged doors, and provides excellent visibility.

The table is 820 x 680 mm incorporating 6 x 18 mm tee slots running parallel to the X axis at 100 mm intervals. The machine can accommodate a working envelope of 700 x 500 mm x 400 mm high assuming 150 mm max tool length.

Slideways

All slideways are hardened and ground with low friction Turcite coating and automatic lubrication. The X and Y axis slideways are 100 mm wide. A fabric cover and flexible metal cover protect the X and Y axis respectively.

Spindle

The 5 bearing spindle is driven directly by 6 vee belts from motor to spindle pulley's providing smooth speed change and reduced noise and vibration. The Fanuc spindle motor is 5.5 kw continuous with 7.5 kw 30 min. intermittent rating. Standard speed range 40 – 4000 rpm (Option: 30 – 3000 rpm) air blast provides automatic cleaning of spindle and adaptor during T.C.

Axis Drives

Gettys-Fanuc Model 5 D.C. Servo motors controlled transistor velosity control unit provide that drive to all axes. The X and Y axis ballscrews are 40 mm dia x 8 mm pitch and the Z axis ballscrew is 40 mm dia x 5 mm pitch.

A.T.C.

The 18 station A.T.C. is situated at the back of the machine table providing easy access to the magazine from the rear of the machine. Tool changes time is a very slick. The A.T.C. protection cover that is located in front of the A.T.C. opens automatically prior to tool change and closes to protect the magazine from the working area. The magazine is operated by Geneva mechanism hydraulically and an air operated slot-pin locks each position.

In the case of 22 station A.T.C. (optional specification), the magazine is driven by D.C. survo motor (FANUC Model 0) and controlled by FANUC made special numerical control system that consists of 1 IC circuit board located inside of electric enclosure box. (This control system doesn't mean 4th axis controllor). Tool change takes place at the machine home position i.e. X axis 30 i.e. X axis 30 mm offset from Table C.

Y axis max. plus. Table towards front
Z axis max. plus (full retract)

This leaves the table completely clear for loading and inspection, etc. The tool change interlocks at this position provide utmost operator safety and ATC protection.

Control

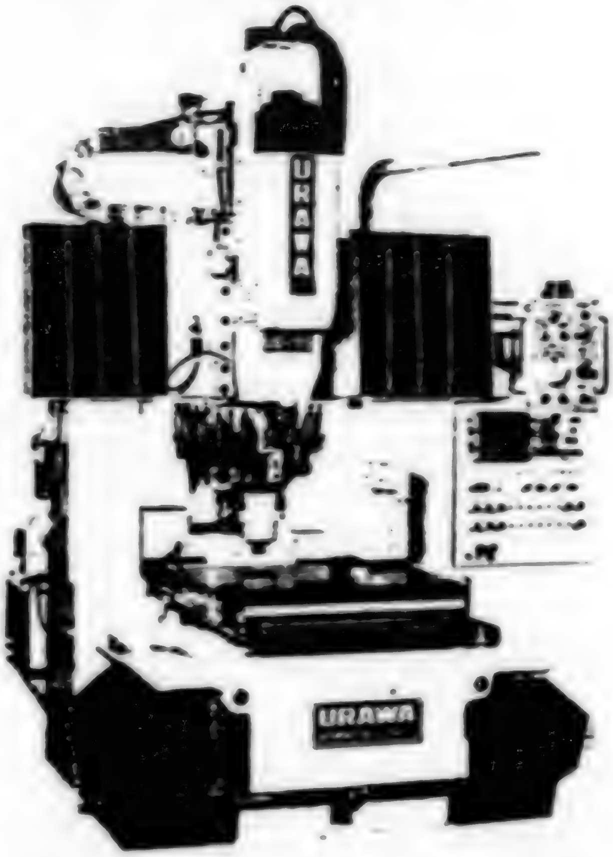
The Fanuc 6M Model B C.N.C. with C.R.T. and the machine control panel are situated at the front right hand side and the tape reader is adjacent along the side of the machine. A pendant is standard housing the operator panel. The A.T.C. can be manually operated thro' the complete cycle which also provides facility for manually loading tools. The controls are well positioned for the operator with joy stick control of X, Y and Z axis, mirror image switches and Z axis feed neglected switch, a good feature for tape proving.

Ancillary Equipment

The hydraulic unit, NC cabinet and servo unit are all neatly positioned within the machine perimeter in area at the rear of the machine. Air is supplied at 4 – 5 kg/cm^2. The two coolant and swarf trays are position at floor level on either side of the machine table. Coolant is pumped down the left hand side of the saddle to the work area. Floor area required is 2.5 mtrs x 2.6 mtrs deep.

Installation

The machine is lifted by wire slings which are passed around two lifting bolts mounted on the bed front and thro' two holes cast in the back of the X axis beam. The machine is levelled at 5 positions 3 primary and 2 secondary point. Bolting down is not necessary.



Specifications

Table	Working surface	820 mm x 680 mm
	Longitudinal travel X axis	700 mm
	Cross travel Y axis	500 mm
	Distance spindle nose to table	150 – 550 mm
	Table load	400 kg
Head	Vertical travel Z axis	400 mm
	Spindle taper	N.T. 40
	Spindle speeds	40 – 4000 rpm (30 – 3000 optional)
Feeds	Cutting feed rate	1 – 3000 mm/min
	Rapid traverse X and Y axis	10,000 mm/min
	Z axis	7,000 mm/min
A.T.C.	No. of tools	18
	Tool selection	Random selection by direction
	Max. tool size	100 x 300 mm
	Max. tool weight	7 kg
	Tool selection	4 seconds
	Chip to chip	Under 10 seconds
Motors	Spindle motor	Continuous DC 5.5 kw
	X, Y, Z axis	DC servo
	Hydraulic motor	1.5 (4P) kw
	Coolant motor	0.18 kw
Required floor space		5.0 m^2 (7750 in^2)
Machine weight		5300 kg

Model AS-355

Angular Slide Grinder

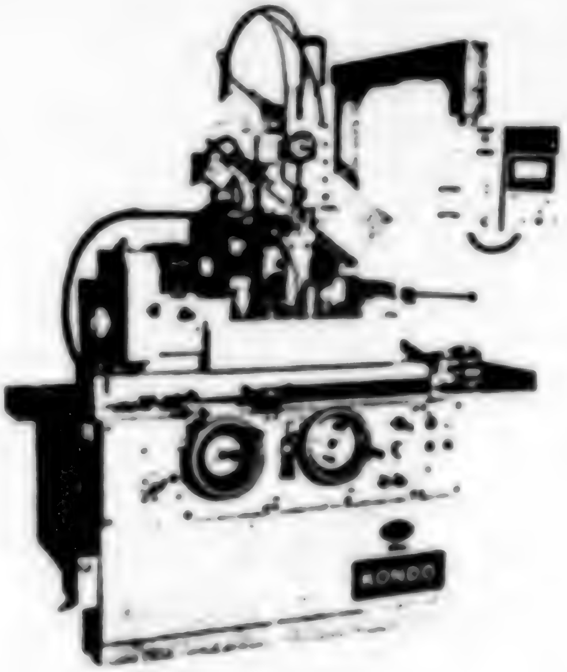
Kondo Machine Works Co., Ltd.

This series has been developed for the purpose of grinding the end surface and the cylindrical portion of the work simultaneously, effectively and accurately, in large lot production through simple operating procedure.

- **Spindle Bearing**
  Hydro-dynamic bearings supporting the spindle ensure high speed and heavy duty grinding operation through minimizing generated heat and diminishing spindle deviation from the center.
- **Highly Accurate Dressing Mechanism**
  Template copying dresser, employing hydraulic servo-valve, provides stable and accurate dressing operation, thus high production accuracy being assured.
- **Wheel Automatic Feed Mechanism**
  Automatic grinding feed is performed hydraulically and mechanically, assuring stable wheel head positioning accuracy.
  Backlash eliminated ball screw, which feeds the wheel head, provides highly accurate infeed.
- **Angle of the Wheel Head Slide**
  Wheel head is feed in the angle of 36° 52' 12". The established angle made it easy to set the grinding amount at the end surface:
  Traverse amount: OD grinding amount: end surface grinding amount = 5 : 4 : 3. Burning at the end surface during grinding, due to the difference of the grinding speed at the outer portion and at the inner portion, can also be diminished by feeding the wheel head at this angle.

Specifications

Capacity	
Swing over table	250 mm
Distance between centers	355 mm
Grindable outer diameter	100 mm
Permissible weight of work (in case of center work)	50 kgf
Grinding wheel	
Size of grinding wheel (outer dia. x width x inner dia.)	ϕ510 x 25 – 75 x ϕ203.2 mm
Rotation speed (without load)	1,125 r.p.m.
Grinding head	
Travel length (screw stroke)	125 mm
Rapid travel length (oil pressure feed)	75 mm
Slide angle	36°52'12"
Manual cutting (regarding dia.)	ϕ200 mm
Per hand wheel rotation (regarding dia.)	ϕ2 mm
Per micro-color graduation (regarding dia.)	ϕ0.005 mm
Table	
Travel length	Manual 400 mm
Travel length of handle wheel per rotation	20 mm
Fine feed	0.01 mm
Turning angle	8°30' – 4°30'

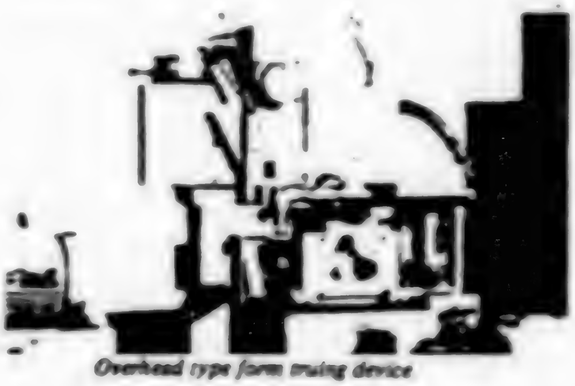


Model UGK-750
Universal Grinding Machine

Kondo Machine Works Co., Ltd.

Precision universal grinder with sharp grinding performance and high stability. This machine is very versatile as a universal grinder. The use of various attachments expands the range of performances of this machine more widely. The UKG-750 universal grinder is very suitable not only for single-part production, but also for mass-production, when the automatic sizing device is incorporated.

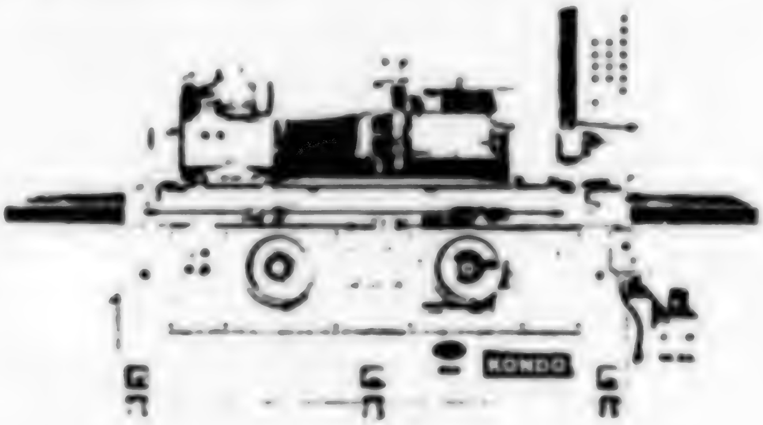
- The Wheel-Spindle Bearing
  The wheel-spindle bearing is a hydrodynamic sliding bearing composed of three supporting areas. It is designed to develop very high oil pressure in oil wedges on the supporting areas. Due to the pressure developed the center of spindle rotation is held rigidly at the center of the bearing opposing against heavy grinding forces applied.
  To suppress the temperature rise of the bearing as possible special measures are adopted so effectively, that the dislocation of the spindle center relative to the workpiece center by thermal influences is kept to the minimum.
- Easy Operation
  To ensure highly efficient production for single-part production, that is, for various kinds of workpieces, and also for mass-production thoughtful considerations have been given to the construction and arrangement to have simple operation and easy adjustment of the machine and also of the attachments.
- Elimination of the Thermal Deformation of the Machine
  To maintain high grinding accuracy by eliminating thermal deformations of the bed caused by the coolant, the heat-insulated passages of the coolant are prepared to avoid the direct contact of the coolant flow with the machine bed.
- Cylindrical Grinder for Mass-Production of Shafts
  As a sister grinding machine of this UGK-750 universal grinding machine the CGK-750 cylindrical grinding machine, which is suitable particularly for mass production, is included in our manufacturing program. The CGK-750 cylindrical grinding machine has neither a swivelling wheelhead nor a swivelling workhead and is arranged only for grinding between dead centers.



Overhead type form truing device

Specifications

Capacity	
Swing over table	300 mm
Distance between centers	750 mm
Max. diameter to be ground	200 mm
Allowable max. weight of workpiece	80 kgf
Wheel-spindle	
Grinding wheel (D x W x d)	ϕ405 x 38 (25 – 75) x ϕ203.2 mm
No. of speed	1
Speed	1,500 rpm
Max. peripheral speed of wheel (standard)	2,000 m/min
Max. peripheral speed of wheel (for special model 45M)	2,700 m/min (2,120 rpm)
Table	
Total stroke	880 mm
Stroke per one rev. of handwheel	20 mm
Swivel angle	8°30' – 4°30'
No. of speeds	Infinite
Traverse rate	10 – 2,000 mm/min



Model GSWN
Thread Grinding Machines

Mitsui Seiki Kogyo Co., Ltd.

Advantages gained by using CNC Control on Thread Grinding Machines

- The use of CNC Control greatly facilitates adjustment and set-up of the machine.
- CNC-Control provides an unlimited variety of pitch dimensions and a very accurate multiple-start thread grinding facility.
- Backlash compensation is adjusted only once during the assembly of the machine and does not have to be done again. Actual backlash of the table drive can thus be held within less than .000040" as compared with more than .000400" on standard thread grinders.
- With CNC Control a wide range of work spindle speeds is available to the operator (.1 to 100 rpm), the lowest speed range being extremely useful for machine set-up and checking the thread.
- There are certain applications which require very accurate table positioning control at the end of the threaded portion of the work piece, so as to avoid interference of the grinding wheel with adjacent shoulders. In these cases NC control provides table positioning accuracy within .000010" which is far more accurate than what can be obtained from table positioning cams on ordinary machines.
- Also, thread profile cylindrical grinding may be performed on a thread grinder equipped with CNC Control taking advantage of the very high positioning accuracy of the machine table resulting in a pitch accuracy of better than .000040" on the work piece.
- When grinding long lead screws CNC Control offers the additional advantage of rapid table return with the work stopped thus avoiding heat generation on the steady rests.
- Lead corrections can easily and accurately be made by entering data into the CNC Control. This is far more accurate than using mechanical correction devices.
- Another useful feature of CNC Control is the programmable correction of lead screw pitch errors in steps of .000008" which permits to cut in half the already extremely high accuracy of MITSUI SEIKI lead screw assemblies.

Model GSWN 1000

- By omitting a large number of mechanical links between drive motor and lead screw, many sources of pitch errors are eliminated.

  Also, separate drive motors for work spindle and lead screw provide more positive control. This means in effect that CNC Control provides better accuracy of table position relative to the angular position of the work spindle which is tantamount to better machining accuracy.
- Occasionally lead screws are required to be manufactured with certain intentional deviations from perfect pitch. While this is very difficult to accomplish on a standard thread grinder which is painstakingly designed and built for linear pitch accuracy, CNC Control provides means of programming any desired amount of erratic pitch pattern.
- For certain applications dual pitch grinding is required, for instance, when grinding worms with variable width of teeth. This is very difficult to do on a standard thread grinder, but becomes an easy job taking advantage of the facilities offered by CNC Control.
- A third axis can be added to the CNC Control of the machine for applications in which simultaneous control of the grinding wheel infeed is required, for instance in the manufacture of special screws for plastic injection machinery. This feature is available as optional equipment.
- CNC Control is also available for the dresser of the machine when highly complex thread profiles are to be ground as is the case with air compressor screws.
- CNC Control is available for both external and internal thread grinding machines manufactured by MITSUI SEIKI.

Specifications

Model	GSWN-1000	GSWN-2000	GSWN-3200
Maximum diameter work ground	200mm	←	←
Maximum diameter swing over table	480 mm	←	←
Maximum work length between centers	1200 mm	2200 mm	3650 mm
Maximum thread portion to be ground	1130 mm	2130 mm	3300 mm
Wheel size	ø510 x 10 – 50 x 228.6 mm	←	←
Maximum wheel speed of wheel	2100 & 2700 m/min	←	←
Maximum helix angle setting on wheel, right or left	±45°	←	←
Net weight	10,000 kg	12000 kg	18000 kg

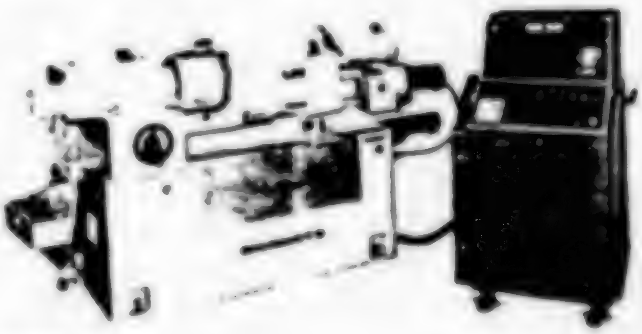
Model IGM-1 ENC
NC Internal Grinding Machine

Okamoto Machine Tool Works, Ltd.

The OKAMOTO NC Internal Grinding Machine Model IGM-1ENC has been designed for high precision and productive internal grinding works with a wheelhead cross feed and a table longitudinal movement numerically controlled and is best suited for various workpieces not only in mass production works but also in small job shop works shown below.

Features

- All electro-mechanical drive permits fast setup, precise movements and low thermal displacement of the machine.
- High grinding concentricity and tremendous grinding time reduction can be obtained as multi-stepped holes, outside and end surfaces are ground in one chucking of workpiece.
- Hard-to-grind materials that require frequent wheel dressing operations can be quickly ground as such complex operations are automatically performed by NC system.
- Uniform grinding accuracy can be obtained as delicate grinding conditions such as wheel longitudinal and cross feeds, dressing amount and dressing speed, etc. are accurately reproduced even in a long period of machine operation.
- The distance (L) between two end surfaces shown in Example (A) can be accurately and quickly ground with this machine which will not be practical in mass production when used conventional internal grinding machine.
- Key board type manual data input and a CRT display provide easy programming corrections which will frequently happen in grinding operations to establish optimum grinding and dressing conditions.



Specifications

Capacity	
Internal diameter to be ground	6 – 100 mm (0.24 – 3.94")
Maximum grinding stroke	200 mm (7.9")
Maximum swing inside splash guard	270 mm (10.6")
Maximum longitudinal table travel	500 mm (19.7")
Maximum cross wheelhead travel	100 mm (3.94")
Speeds and Feeds	
Table longitudinal movement (Z axis)	
Least input increment	0.001 mm (0.0001")
Automatic feed	0.1 – 5000 mm/min
Rapid feed	5000 mm/min (197 ipm)
Wheelhead cross movement (X axis)	
Least input increment	0.001 mm (0.0001") in diameter
Least command increment	0.0005 mm (0.00005")
Automatic feed	0.1 – 800 mm/min
Rapid feed	800 mm (31.5")
Wheel spindle speed range	10000 – 60000 rpm
Work spindle speed	100 – 800 rpm

Model NFG-52
Precision NC Profile Grinding Machine

Okamoto Machine Tool Works, Ltd.

Patented Unique Grinding System Offers Precision Profile Grindings with Great Flexibility

The OKAMOTO Precision NC Profile Grinding Machine Model NFG-52 has been specifically designed for high precision profile grindings with a saddle and a wheel head numerically controlled and is best suited for the finishing of various kinds of workpiece such as punches, dies, templates, cams, formed cutting tools, gauges, gears and other precision parts. OKAMOTO's patented unique grinding system affords wide range of grinding applications and high grinding accuracy with our ample experiences on NC profile grinding machines in past over ten years as a pioneer in the world.

Unique Grinding Systems (Patent)

A wheel dressing device with a single arm is supplied as an option and mounted on the right end of table. A diamond tool with a roof shape is attached on the top of arm. This arm is tilted in three positions in order to avoid interferences between diamond tool and the wheel whose motions are automatically controlled by NC command. Our unique design concept on NC profile grinding is based on following three kinds of methods.

- Plunge Grinding Method

Grinding wheel periphery is numerically trued in connection with a profile of workpiece and grinds the workpiece by plunge grinding method. This method is suitable for production grinding of narrow parts. For the grinding of wider parts, two or more operations are combined by changing of the grinding wheels.

- Contouring Grinding Method

Grinding wheel periphery is numerically trued to a simple round form. The saddle which is mounting the workpiece and the wheel are numerically moved corresponding to the profile of workpiece. This method is suitable for wider profile grinding and for the grinding of tungsten carbide necessitating a use of diamond wheel.

- Compound Grinding Method

This combines aforementioned two methods and suitable for the grinding of workpieces with identical profiles in succession, such as racks, gears, etc. Gears are ground with an automatic indexing head supplied as an option. Optimum tooth profile modification on gears and racks are easily obtained with simple programming changes.

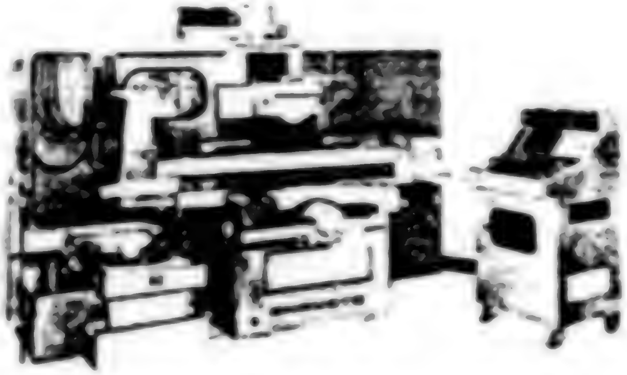
Specifications

Capacity	
Table working surface (Length x width)	550 x 200 mm
Maximum table travel (Manual Longitudinal x cross)	605 x 230 mm
Maximum distance under 205 mm dia. wheel to table top	397 mm
Maximum permissible weight of workpiece on the table	200 kg
Table	
T slot Width x number	17 mm x 1
Longitudinal feed	
Hydraulic	0.3 – 25 m/min
Hand feed per revolution	47 mm
Manual cross feed	
Hand feed per revolution	0.1mm
Hand feed per one graduation	0.001 mm
Continuous feed	0 – 500 mm/min
Minimum increment	0.001 mm
Automatic cross feed	
Step feed per stroke	0.001 – 0.5 mm
Continuous feed (F4 digits)	1 – 600 mm/min
Rapid cross feed	600 mm/min

Model NFG-63
Precision NC Profile Grinding Machine

Okamoto Machine Tool Works, Ltd.

The OKAMOTO Precision NC Profile Grinding Machine Model NFG-63 has been specifically designed for high precision profile grindings with a saddle and a wheel head numerically controlled and is best suitable for the finishing of various kinds of workpiece such as punches, dies, templates, cams, formed cutting tools, gauges, gears and other precision parts. OKAMOTO's patented unique grinding system affords wide range of grinding applications and higher grinding accuracy with our ample experiences on NC profile grinding machines in past over ten years as a pioneer in the world.



Features

- Movements of Wheel and a Workpiece Are Controlled with a Minimum Increment of 0.001 mm.
  - Intricate and fine forms can be ground which are completely impossible with other model.
  - Wheel dressing operations prior to a final finishing with a minimum stock removal remained ensures high accuracy as per programmed configuration of workpiece due to a neglection a wear of grinding wheel in final grinding operation.
- All Operations Are Actuated by a Tape
  - Multi machines can be operated by one operator.
  - No man operation of the machine for long time provides higher working rate of the machine.
- All Grinding Conditions Are Punched in the Tape
  - Skill is not an important factor in the operation of the machine.
  - Less deviation can be expected on the quality of the workpiece.
  - Forms and grinding conditions are easily changed and modified by programming.
  - Reproduction of the workpiece is easy even after a long time interruption of the operation.

Specifications

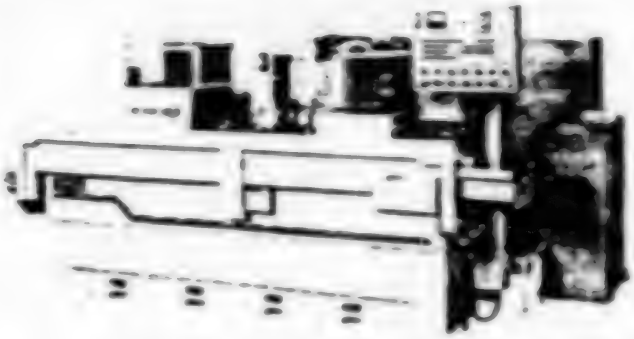
Capacity	
Table working surface (Length x width)	600 x 300 mm
Maximum travel of table (Longitudinal x cross)	800 x 330 mm
Maximum distance under 305 mm dia. wheel to table	347.5 mm
Dimension of standard magnetic chuck	600 x 300 x 108 mm
Table	
T slot (Width x number)	17 mm x 3
Longitudinal feed (hydraulic)	0.5 – 25 m/min
Hand feed per revolution	69 mm

Model GB32A-32x100
CNC/CBN Production Cylindrical Grinder

Toyoda Machine Works, Ltd.

- A Newly Developed CNC/CBN Production Angular Wheelslide Cylindrical Grinder. Designed for the Economical Production of Quality Components Having Multiple Diameters, Shoulders, Tapers and Fillet Radii in One Loading with a Long-Lasting Super Abrasive-CBN Wheel.

- Improved Productivity
  Highly efficient grinding through maximum utilization of CBN wheel's outstanding characteristics and CNC's inherent versatile capabilities.
  Production of quality components through programmed automatic grinding cycles and superb cutting performance of a long-lasting CBN grinding wheel.
  Compact and rugged machine design aimed at taking full advantage of CBN wheel's intrinsic capabilities. Drastic reduction in wheel changeover time and setup time.
  Substantial reduction in non-productive time through rapid wheelfeed rate of 7m/min (267 ipm) and table rapid feedrate of 13m/min (512 ipm).
- Higher Reliability
  Highly consistent accuracy and long-life performance assured by TOYODA STAT BEARING for the wheel spindle.
  TOYODA-developed CNC system integrated with a simple machine construction for added reliability. More expanded self-diagnous functions for minimized downtime and higher machine utilization.
  TOYODA-engineered universal programmable sequence controller TOYOPUC supplied as standard equipment for even higher reliability and better serviceability.
- Full Measure of Safety and Better Work Environment
  Newly developed E.M.I. (Electrical Mechanical Interlock) for safety control of rapid feed.
  Strong wheel guard built to OSHA's safety requirements.
  A really quiet machine engineered with a full measure of noise abatement.
- Unmatched Easy Operation
  Centralized front operation panel for easier operation and monitoring.
  A standard handy operation panel (MDI) for on-machine entry of grinding data without tape preparation.
  Fast entry of grinding data through an optional cassette tape loader.
- More Energy Saving
  Use of power saving valves with minimal hydraulic power unit serves saving more of energy.
  Neatly packaged machine and control with CNC form a compact unit, saving floor space.



Specifications

Swing over table	320mm (12.6")
Distance between centers	1,000mm (39.4")
Diameter to be ground	0–150mm (0–5.91")
Max. load held between centers	250kg (550lbs.)
Automatic rapid feed stroke	80mm (3.15")
Rapid wheelfeed rate	7,000mm/min. (276ipm)
Min. increment per pulse	0.001mm on dia. (0.00004" on dia.)
Grinding wheel OD x Width x ID	355x38x152.4mm (14x1.5x6")
Grinding wheel speed	2,690 rpm
Grinding wheel surface speed	50m/sec. (9,800sfm)
Table rapid feedrate	13,000mm/min. (512ipm)
Min. increment per pulse	0.001mm (0.00004")
Workhead center taper	MT No. 4
Spindle speed	30–360rpm, infinitely variable
Footstock center taper	MT No. 4
Max. retracting stroke of center	60mm (2.36")
Taper correction amount	±0.1 mm (±0.004")
Electric motor	
for wheel drive	11kw (15HP) 4P
for work drive	1.0kw (1.3HP) 6P
for wheelfeed	1.1kw (1.5HP) DC
for hydraulic oil pump drive	0.75kw (1.0HP) 4P
for lubricant pump drive, wheel	0.75kw (1.0HP) 4P
Spindle bearings	
for coolant pump drive	0.25kw (0.3HP) 2P
for table feed	1.1kw (1.5HP) DC
Tank capacity	
for hydraulic drive oil	50 ℓ (13.2gal.)
for lubricant, wheel spindle bearing	40 ℓ (10.6gal.)
for coolant	300 ℓ (79.3gal.)
Floor space required	5,900x2,400mm (233x95")
Net weight	6,300kg (13,900lbs.)

Model G42A-32x63
CNC Production Cylindrical Grinder

Toyoda Machine Works, Ltd.

- A Newly Developed CNC Production Angular Wheelslide Cylindrical Grinder Raises Total Productivity.

- Improved Productivity
  Highly efficient grinding through maximum utilization

of CNC's inherent versatile capabilities.

Production of quality components through automatically controlled grinding cycles.

Substantial reduction in non-productive time through rapid wheelfeed rate of 7 m/min (276 ipm) and table rapid feedrate of 13 m/min (512 ipm).

Drastic reduction in wheel changeover time and setup time.

- Higher Reliability

  Highly consistent accuracy and long-life performance assured by TOYODA STAT BEARING for the wheel spindle.

  TOYODA-developed CNC system integrated with a simple machine construction for added reliability.

  More expanded self-diagnosis functions for minimized down-time and higher machine utilization.

  TOYODA engineered universal programmable sequence controller - TOYOPUC - supplied as standard equipment for even higher reliability and better serviceability.

- Full Measure of Safety and Better Work Environment

  Newly developed E.M.I. (Electrical Mechanical Interlock) for safety control of rapid feed.

  Strong wheel guard built to OSHA's safety requirements.

  A really quiet machine engineered with a full measure of noise abatement.

- Unmatched Easy Operation

  Centralized front operation panel for easier operation and monitoring.

  A standard handy operation panel (MDI) for on-machine entry of grinding data without tape preparation.

  Fast entry of grinding data through an optional cassette tape loader.

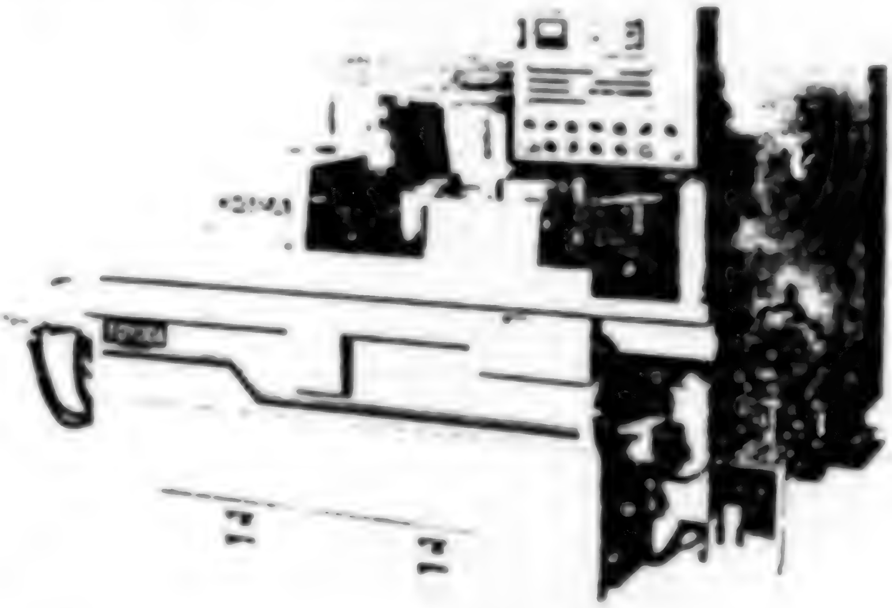
- More Energy Saving

  Use of power saving valves with minimal hydraulic power unit serves saving more of energy.

  Neatly packaged machine and control with CNC form a compact unit, saving floor space.

Specifications

Swing over table	320mm (12.6")
Distance between centers	630mm (24.8")
Diameter to be ground	0–150mm (0–5.91")
Max. load held between centers	100kg (220lbs.)
Automatic rapid feed stroke	80mm (3.15")
Rapid wheelfeed rate	7,000mm (276ipm)
Min. increment per pulse	0.001 mm on dia. (0.00004" on dia.)
Grinding wheel OD x Width x ID	455 x max. 100 x 152.4mm (18 x max. 3.94 x 6")
Grinding wheel speed	1,885 rpm
Grinding wheel surface speed	45m/sec. (8,850sfm)
Table rapid feedrate	13,000mm/min. (512imp)
Min. increment per pulse	0.001mm (0.00004")
Workhead center taper	MT No. 3
Spindle speed	30–360rpm, infinitely variable
Footstock center taper	MT No. 3
Max. retracting stroke of center	40mm (1.57")
Taper correction amount	±0.1mm (±0.004")
Electric motors	
for wheel drive	7.5kw (10HP) 4P
for work drive	0.75kw (1.0HP) 6P
for wheelfeed	0.8kw (1.1HP) DC
for hydraulic oil pump drive	0.75 kw (1.0HP) 4P
for lubricant pump drive, wheel	0.4kw (0.5HP) 4P
Spindle bearings	
for coolant pump drive	0.25kw (0.3HP) 2P
for table feed	1.1kw (1.5HP) DC
Tank capacity	
for hydraulic drive oil	50ℓ (13.2gal.)
for lubricant, wheel spindle bearings	40ℓ (10.6gal.)
for coolant	200ℓ (52.8gal.)
Floor space required	2,830x2,415mm (112x95")
Net weight	4,700kg (10,400lbs.)



Milling Machine

Model AM1547

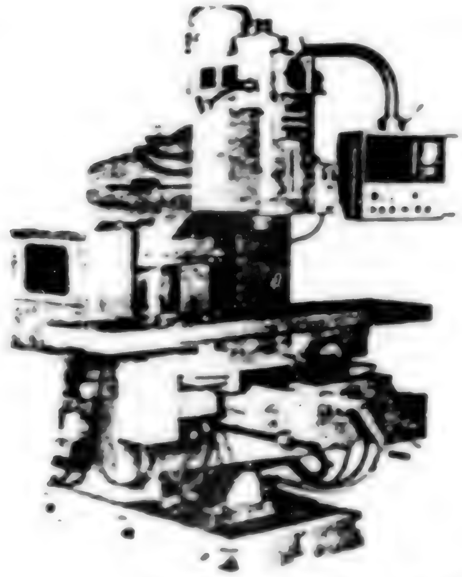
CNC Vertical Milling Machine

Enshu Limited

The ACCU-MILL is a highly accurate performer specially designed with both accuracy and dependability in mind. Many features are carefully built into the machine to assure maximum ease of setup and operation.

Specifications (mechanical portion)

Spindle drive motor	3 kw (continuous) (AC 220/440V)
Spindle speed range	infinitely variable from 75 to 3,500 rpm
Table size (working surface)	381 x 1,194 mm
Table T-slots	four 18 wide T-slots every 80 spacings
Table longitudinal travel (X axis)	762 mm
Saddle cross travel (Y axis)	393 mm
Quill vertical travel (Z axis)	152 mm
Knee vertical travel	444 mm
Quill diameter	110 mm
Spindle nose to table top distance	13 (min.) – 457 (max.) mm
Spindle center to column ways	406 mm
Spindle taper	NST-40
Rapid traverse rate (X & Y axes)	7,620 mm/min
(Z axis)	3,810 mm/min
Feed range (X & Y axes)	0 – 3,810 mm/min
(Z axis)	0 – 3,810 mm/min
Positioning accuracy	±0.02/300 mm
Positioning repeatability	±0.005 mm
Maximum weight of workpiece	450 kg
Machine weight	2,500 kg
Floor space	2,556 x 1,850 mm
Machine total height	2,225 mm



Features

- Direct-reading RPM indicator dial for easy speed selection (programmed speed changer is optional).
- Manual pulse generator, 3 axes selective, by x1, x10, x 100.
- 152 mm quill travel for extended machining depth. 110 mm diameter quill with automatic (programmed) quill clamp system. Quill feed range: 0-3,810 mm/min.
- Tape reader for easier operation and effective machining. Tape punch interface of ASR33.
- Rectangular column ways assure rigid knee support.
- Extra heavy-duty knee, saddle, table & column combination is designed for CNC milling operation.
- Hardened and precision ground saddle ways on the massive knee.

Heavy Duty Construction

Massive 970 mm wide saddle, and 510 mm wide knee way support large table and 450 kg workpiece. 110 mm diameter quill holds heavy cutting.

Machining Capacity

Milling capacity (by ϕ100 mm face mill): 164 Cu. cm. in Aluminum, 100 Cu. cm. in Cast Iron, 65 Cu. cm. in Mild Steel. (by HSS ϕ20 mm end mill): 37 Cu. cm. in Cast Iron, 25 Cu. cm. in Mild Steel. Drilling Capacity: ϕ 35 mm in Mild Steel.

Accuracy

Positioning accuracy: ±0.02/300 mm

Repeatability: ±0.005 mm

Standard Accessories for ENSHU/FANUC System 3M

Controlled axes: 3 axes (X, Y, and Z). Simultaneously controlled axes: 2 axes. System resolution: 0.001 mm. Keyboard manual data input (MDI). CRT character display. Decimal point programming. Selective absolute/incremental programming within the same block of data. Programming of absolute coordinate zero. Positioning, linear and circular interpolations across different quadrants. Buffer storage. Dwell. Cutter compensation B: ±6 digits, G39, G40, G41, G42. Tool Length Offset: ±6 digits, G43, G44, G49. (up to 32 sets in total of cutter compensation B and tool length offset values). Manual pulse generator. Dry run. Self diagnostics. Backlash compensation. Single block. Optional block skip. Machine lock. 4 Digit sequence number display. Sequence number search. Program number search. Manual/automatic return to reference point. Canned cycle (G80 thru G89). Constant tangential feedrate control. Mirror image with respect to X and Y axes. Inch/Metric conversion. Tape reader. Part program storage and editing: 10 m of tape information. Stored pitch error compensation.

Model EDN-64 with Fanuc 6MB
Super Precision Die Sinking and Engraving Machine

Iida Machinery Co., Ltd.

Super precision die sinking and engraving machine Model EDN-64 has been developed to meet various requirements of super precision and high productivity of die sinking, engraving and milling operations. Outstanding features of Model EDN-64 are as follows.

* Rugged construction of the bed, column, saddle and spindle head.

* 3-point levelling screw support of the bed.

* Wide selection of the spindle unit for various operating conditions
  - cutting diameter, workpiece material and surface finish, etc. The air turbine driven spindle is available to meet special requirements. All spindles are easily replaced on the spindle head.

* Extremely accurate and smooth feed motion on each axis – table (X) saddle (Y) and spindle head (Z). The error of feed and positioning against NC command of 0.001 mm resolution is less than 0.001 mm.

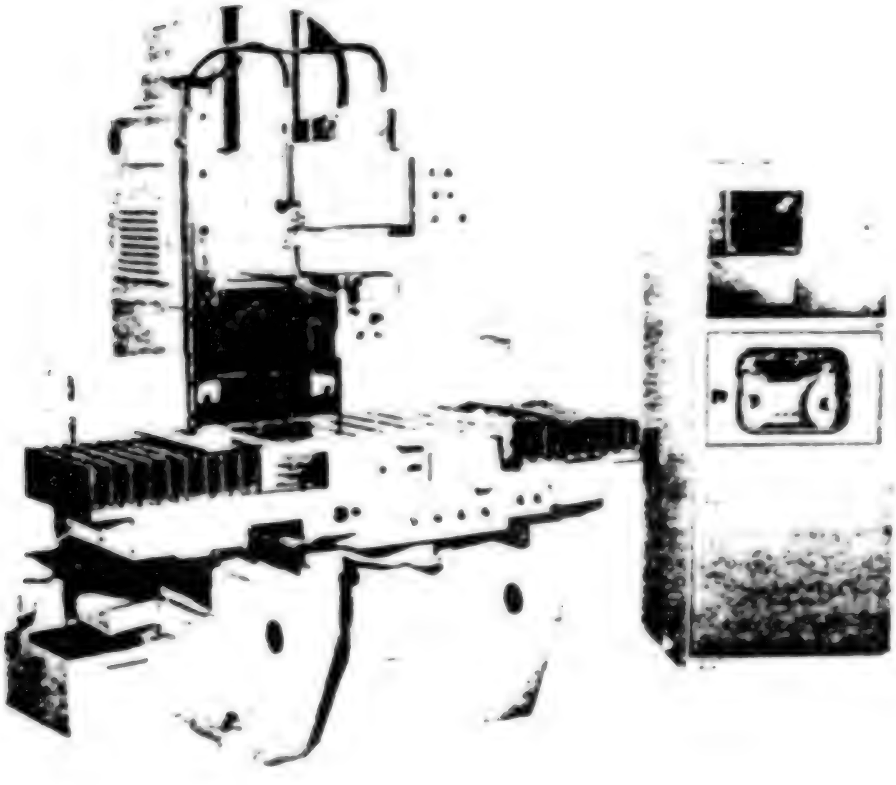
  Less than 0.001 mm accuracy can be achieved because.
  - All slideways are hardened and ground and opposite surfaces are covered by almost friction free fluoride plastic, which prevents from any overhang.
  - All ball-screws are located in the center of sliding ways.
  - Special coupling (System) with almost no backlash is employed for connection of ball-screw and D.C. servo motor.
  - No stick-slip and snake-move are occurred in the feed of table, saddle and spindle head due to those unique construction.

* Less thermal deflection due to low temperature rise and cooling air circulation out of machine assures the accuracy stability for continuous operation.

* All operating switches/buttons are divided into two groups according to their operating functions and frequencies and placed within each reach of the operator.

* The table T-slots are provided transversely instead of longitudinally for convenience of chip and coolant disposal and workpiece clamping arrangement.

* The latest Fanuc 6MB control unit is equipped as standard.



Planomiller
Model OPM-711

Kotobuki Industry Co., Ltd.

Features

- The cross rail is fixed securely with the column, both of them have sufficient rigidity. And so, the accuracy of squareness is very superior at the both planes of horizontal and vertical plane
- Rail-head is ram type, and is put into the saddle by rational method. And it does long precise travelling vertically on the saddle
- This machine can cut accurately right angled plane to the table surface by means of angle attachment set tightly to the spindle nose of the rail-head.
- Each of table feed, rail-head cross and vertical feed can be varied infinitely on the pendant switch box by D.C. motor.
- In addition to all kinds of milling work, boring work of top surface and four side face of the workpiece can be done precisely.

Standard Accessories

Handles and wrenches. Foundation bolts and leveling bolts. Arbor for 150mm (6") dia. cutter, Centering plugs, Draw-in bolts.Cutter fixing bolts. Lighing device for working. Tool cabinet.

Optional Accessories

Quill feed equipment of column head. Angular attachment, Universal angular attachment. Coolant equipment, Optical measuring device. Digital read-out device with MAGNE SCALE. A variety of arbors, A variety of automatic cycles.

Standard Accessories

Handles and wrenches. Foundation bolts and levelling bolts. Arbor for 150 mm (6") dia. cutter, Centering plugs, Draw-in bolts. Cutter fixing bolts. Lighting device for working. Tool cabinet.

Optional Accessories

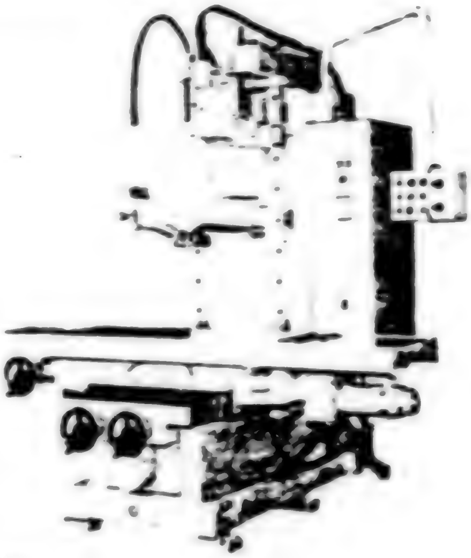
Quill feed equipment of column head. Angular attachment. Universal angular attachment. Coolant equipment, Optical measuring device. Digital read-out device (with MAGNE SCALE). A variety of arbors. A variety of automatic cycles

Model KMV-450
Bed Type Vertical Milling Machine

Kotobuki Industry Co., Ltd.

Features

- The saddle is lengthened to minimize over-hang of table, so it ensures high durability and makes possible highly accurate machining.
- Mountain-shaped telescopic covers made of sheet steel are located at the rear of saddle, and thus enables easy removal of dust and chips.
- All handwheels are located at the front of machine to give highly superior operative function.
- Ball screws are adopted for each feed screw, so manual feeding operation can be done smoothly.
- Each feed equipment is provided with D.C. motor, so feed rates are infinitely variable.



Specifications

Main body

Table width	450 mm
Table length	1,400 mm
Table longitudinal travel (X)	1,000 mm
Table crosswise travel (Y)	400 mm
Head travel (Z)	500 mm

Specifications for Planomiller Model OPM-711

Series	18	25	30	36
Table width	750 mm			
Table length	1800 mm	2500 mm	3000 mm	3600 mm
Table travel	1750 mm	2450 mm	2950 mm	3550 mm
Table working surface	750 mm x 1500 mm	750 mm x 2200 mm	750 mm x 2700 mm	750 mm x 3300 mm
Bed length	3710 mm	5110 mm	6110 mm	7310 mm
Loading capacity	2.5 tons	3.5 tons	4.0 tons	4.5 tons
Floor space	3100 mm x 5530 mm	3100 mm x 6750 mm	3100 mm x 7750 mm	3100 mm x 8950 mm
Net weight (about)	11 tons	13 tons	14 tons	15 tons

Distance from spindle nose to table top	100 mm – 600 mm
Distance from column front to spindle centerline	475 mm
Height of machine	2,650 mm
Floor space	3,400 mm x 2,300 mm
Net weight approx.	4,800 kg
Feed equipment	
Range of feed rates (X, Y)	0 – 4,000 mm/min
Range of feed rates (Z)	0 – 4,000 mm/min
No. of feed rates (X, Y, Z)	infinitely variable
Rapid traverse (X, Y)	6,000 mm/min
Rapid traverse (Z)	4,000 mm/min

RB Series
Precision Vertical Boring and Milling Machine

Shin Nippon Koki Co., Ltd.

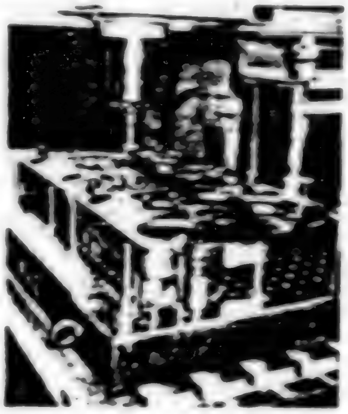
Designed to meet customer's requirements based on previous 1,500 units' experience with reliability a special characteristic

Main Features

- Advantages of Vertical Type
  - High accuracy due to the stable center of gravity of the workpiece
  - Easy set-up
  - Can be used as a production jig borer
- A variety of options (e.g. Automatic work changer)
- Can be provided with any NC system at customer's request

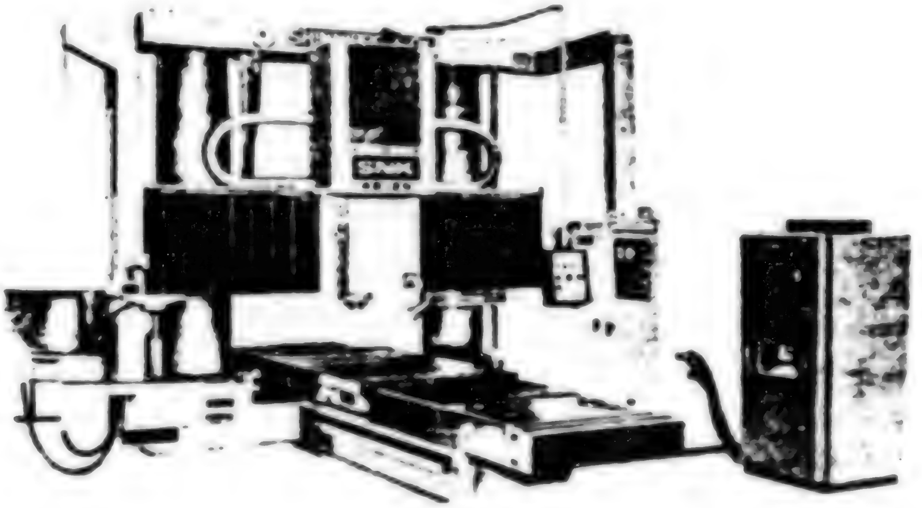
Specifications for RB-2N

Effective distance between columns	1,650 mm
Table working surface	1,200 mm x 2,000 mm
Distance, table surface to spindle end	1,300 mm
Max. table load	5,000 kg
Table travel (X)	2,350 mm
Spindle head travel (Y)	1,600 mm
Spindle quill stroke (Z)	400 mm
Crossrail elevating travel	1,000 mm
Rapid feed (X, Y)	7,200 mm/min
Rapid feed (Z)	3,600 mm/min
Cutting feed	1 – 3,600 mm/min
Spindle speed	30 – 2,000 rpm
Spindle/quill diameter	100/185 mm
Spindle nose taper	AST No. 50
Spindle drive motor	DC 22 kw



Options

Automatic tool changer Tool storage capacity:	24
Spindle speed:	30–3,000 rpm (with DC motor)
Others:	Automatic work changer. Chip conveyor. Can be provided with any NC system at customer's request. Adaptive control device. Thermal displacement compensator. Self-diagnosis function. Tool break detector. Number of tools stored in magazine up to 40.



TOMEC Series TMC-3, TMC-4

CNC Lathe

Nakamura-Tome Precision Industry Co., Ltd.

Heavy Duty Precision Spindle to Assure Rigidity

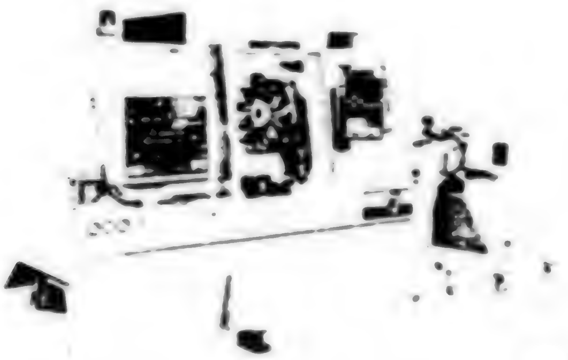
This portion carries an aspect which makes Nakamura-Tome first again. A rigid spindle of large diameter has two-point suspension for the very highest rotational accuracy: The spindle is supported by a pair of angular contact bearings and super-precision double-row cylindrical roller bearings in the front and super-precision double-row cylindrical roller bearings in the rear.

Rugged Box-Type Headstock Houses No Speed Gears

All speed gears are isolated from the headstock. The absence of gears in the headstock makes for temperature stability and quiet operation; This unique design virtually eliminates the inaccuracies inherited from heat and vibration to be generated in headstock gearboxes. The final spindle drive from the main motor through the transmission unit separately furnished via multi vee belts guarantees smooth rotational stability even at the highest speeds and heaviest cutting loads.

DC Spindle Drive to Suite Your Exact Job Requirement

The optimum spindle speed is selectable through an SCR controlled DC Motor with auto-shifting transmission unit. This arrangement optimizes individual cutting efficiency through rpm with due torque or sufficient power to meet with production needs. The infinitely variable DC motor also provides the facility of constant surface speeds in combination with a highly sophisticated CNC function increasing tool life and giving consistent surface finishes.



TMC-3

Massive Torque-Tube Bed for Stability

The strong "Torque-Tube Bed" ensures high rigidity of TMC-3 and TMC-4 and allows "chatter-free" turning without risk.

The slideways are hardened and ground and coated with "TURCITE B." Fluorine type plastic which makes the constant machining of top quality parts possible.

12 Tools on Massive Disc Turret Designed Unique to Minimize Setup Time

Each tool holder is easily mounted on a disc type turret by fastening only one screw. This quick-change tooling minimizes setup time. A precision curvic coupling ensures super accurate positioning and powerful hydraulic clamping is provided for heavy cutting loads. The bi-directional indexing turret always takes the shortest route to the next station.

Powerful Slide Feed Unit

The reliable high-torque DC servo motors and massive ball screws are mated to provide the maximum thrust required for large bore drilling and for high speed turning with ceramic tools.

Compact Design for Easier Operation

Operator's panels, swing-out type, are designed to allow easy access to the operator. Also provisions have been made for instant identification of the cause of any malfunction as well as for fast and simplified repair.

Slant-Bed for Easier Chip Disposal

The 60 degree slant bed design allows easy chip disposal and provides ideal operator access for chuck loading and unloading. The chip tank which is located away from the bed ensures there are no problems with temperature increases from hot swarf. An optional chip conveyor is available along the front area with no infringement on operator's access for operation.

TMC-4

Options

Slide-In Type Tailstock: This hydraulically actuated and tape controllable "Slide-In" type tailstock allows instant machine conversion for shaft work.

Parts Unloader: This attachment, hydraulically operated and programmable, carries the cut-off workpiece away from the machining area automatically onto the chute.

Model LC30
Numerically Controlled Lathe

Okuma Machinery Works Ltd.

Easy Loading. Easy Tool Changing.
Easy Chip Handling.

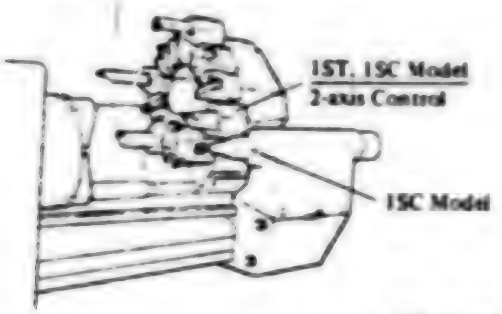
Bet you can't find a bigger or better 12-station turret in its class. Enough well-supported tools to tackle practically any job, skip-indexing in either direction with an ultra-accurate coupling, and plenty of power – 22 KW 30 min. rated DC drive – for real metal hogging, plus constant surface speeds for fine finishes in practically any material!

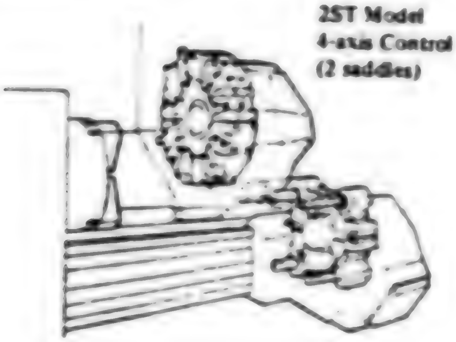
The extreme structural rigidity guarantees massive, precise cuts without a shudder.

All in a downsized, spacesaving package together with Okuma's world-renowned CNC (OSP 3000L). If you need flexibility, tremendous capacity and extraordinary ease of operation, the answer is Okuma.

The LC30 series offers powerful chucking in a convenient 2-axis control model, the 1ST.

A tailstock is available as the 1SC model. The 2ST model of the series features simultaneous 4-axis control for twice the productivity from 2 saddles.





Features

- V12 Big Turret
- Complete flexibility from 12-station permanent set-up saves time and slashes costs
- Consistently powerful, stable cuts from heavy-duty clamping system 4500 kg with large diameter coupling.
- Time-and moneysaving skip-index system insures maximum uptime. No "station" stops along the way.
- Indexes in either direction. Indexing time: 2 sec. (face to face)

- Poweful DC Drive Motor

The husky main motor (DC 22 kw) provides powerful drive for shorter chucking time and longer tool life. Standard-equipped on the 2-saddle model (2ST) is a DC 30 kw motor. All the muscle you need for real hogging.

- 3-Point Spindle Support

The 3-point spindle support developed by Okuma has been acclaimed for the tremendous rigidity it offers across high speeds in heavy hogging. Double-row Cylindrical Roller Bearings and Angular Thrust Ball Bearings insure stable cuts at up to 3000 rpm. The 77 mm spindle bore enables you to handle bar work too.

Spindle dia.: 120 mm
Spindle bore: 77 mm

- Rugged, Rigid Bed Construction

This special Okuma designed slant bed and overall construction are solid throughout. Chips fall directly from the cutting point or bed to the optional chip conveyor below. The distance from the spindle center to bed sliding ways is minimal despite the size of the massive 12-station turret.

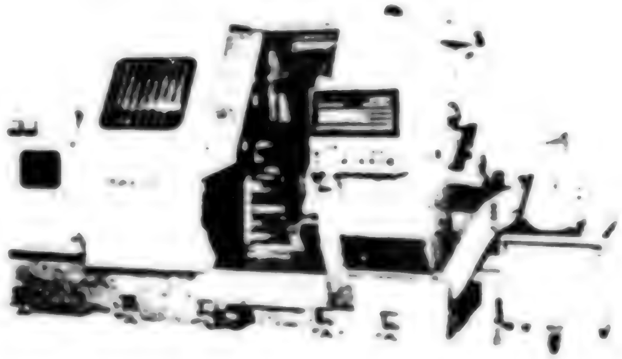
- Extreme Precision – Maximum Accuracy Always
- X, Z ways are ground and hardened, with force-feed lubrication, so as to maintain high accuracy under hears of heavy operation.

- Pinpoint positioning accuracy from ultraprecise ball screw action.
  Force-feed lubrication for long life.

- Consistently close tolerances are possible because of the standard output increments of 0.001 mm on either axis (X,Z). (Tape input: 0.01 mm)

- High indexing accuracy, despite large turret size, close tolerances from use of very precise coupling action.

Slide Repeatability:	X axis . . . . . ±0.001 mm
	Z axis . . . . . ±0.002 mm
Slide Thrust (15 min. rating):	X axis . . . . 850 kg
	Z axis . . . . 1500 kg
Turrets Index Accuracy:	±1.5 seconds of arc
Turret Clamping Force:	4500 kg
Turret Index Speed	2 seconds per position
Max. Allowable Weight on Spindle, incl. chuck:	180 kg (chucking work)



Model LC20-2S
4-Axis CNC Chucker

Okuma Machinery Works Ltd.

- 16 tools for virtually unlimited turning flexibility multiple-lot work.
- Simultaneous OD/ID cuts on 2 independent slides.
- NC robot for automatic setup and removal of various work.
- Auto work gaging system for tool offset automation and control of work dimensioning.
- Safe, continuous operation, thanks to Okuma Monitoring Systems.
- Full flexibility from the new Okuma OSP3000L CNC

The OSP3000 is a minicomputer-based CNC series featuring not only the conventional NC functions but many other unique Okuma systems. Controlling the machine through a full array of cost-efficient software, this OSP3000L can be expanded, continually updated and adapted in terms of diverse specifications.

Specifications

Swing over bed	φ400mm
Max. turning dia. x length	φ300 x 230 mm
Type of spindle nose	ASA A2-6
Spindle bore diameter	φ52 mm
Number of spindle speeds	Stepless x 2 (Auto)
Range of spindle speed	65 to 3500 rpm.
Rapid traverse speed, X-axis	5 m/min.
Z-axis	10 m/min.
Type and No. of tool stations	Auto. vert. V8 + V8
Main motor	DC 15/22 kW (Cont./30 min.)

Try this cost-efficient Okuma programmable robot. Ideal for multiple medium- or small-lot production.

The machine control-unitized robot and turntable combination provide automatic setup and removal of different types of work. The savings in time and labor are immense.

- Minimizes setup and removal time.
- No congestion at front of machine. Allows complete operator access as desired.
- Programmable robot arm offers a wide selection of positions to fit with any process.
- Your choice of horizontal attitudes, positioning heights.
- Extremely easy, flexible maneuverability from tape operation and teach control (playback). Easily taught on the job.
- Simple robot movements from the turntable.
- Fully unitized control of the machine and robot operations under Okuma's own OSP 3000L CNC control.

Okuma Robot Specifications

Load capacity
5 kg x 2, 10 kg x 1 (Chuck work: usually double hand)
Workpiece size
φ20– φ150 x 120 mm (Chuck work)
φ20–φ100 x 500 mm (between-centers work)

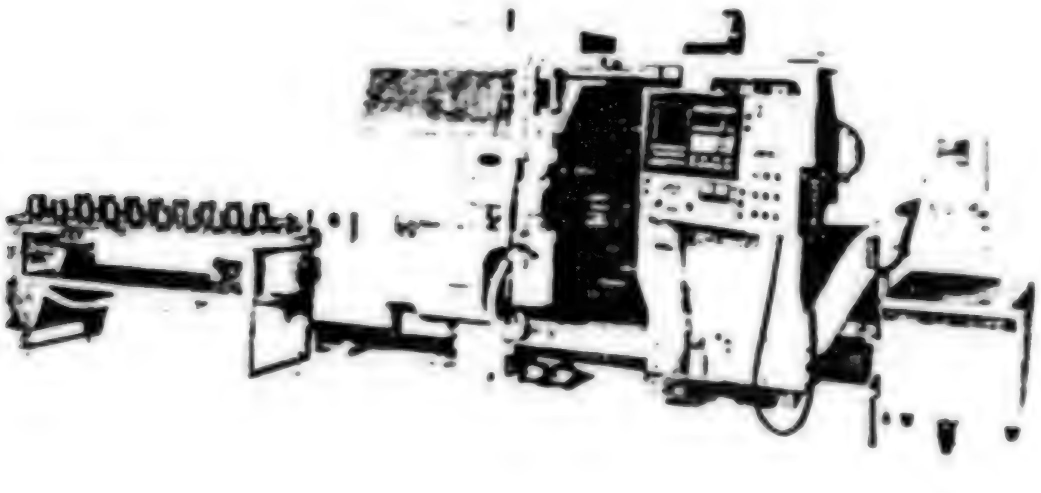
Accuracy

Positioning accuracy	±0.15 mm
Absorption of eccentricity	±1 mm
Absorption of deflection	±1.5°

Automatic Work Gaging System

The superlative Okuma gaging system can provide fuller automation for long or short runs. Okuma's outstanding reliability, innovative and rich array of software are the reasons why this efficient measuring system brings the day of full automation a giant step closer.

- The work gaging system using the unique touch sensor works off the Okuma OSP absolute coordinate system. Thus, high reliability is achieved without the need for a special detector (magnescale, inductosyn, etc.).
- Just one gaging head is used to measure workpiece OD, ID and end face. And the high-precision sensing switch and switch for over travel protection have a very simple, built-in construction.
- The OSP software handling provides immediate feedback of the measured data. The results are translated directly into accurate offsets. No manual operations are needed to measure.



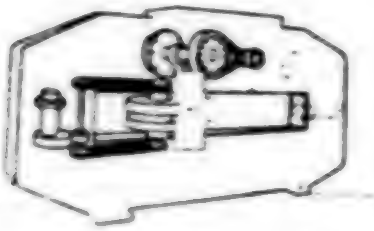
NCT COMA Series
Triple Track Turret Punch Press

Amada Company, Ltd.

Turret Punch Press with "Yaw-Free" Bridge Frame Construction

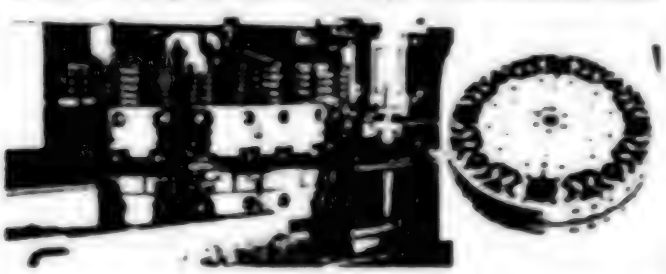
The COMA press frame is a bridge-type, welded steel design, closed at the sides. This frame resists without deflection the opposing forces arising during operation and eliminates the "yawing" usually associated with C-shape frames. The results are extreme accuracy and considerable lengthening of the tool service life.

In addition, no special foundations are required for COMA series presses – an additional advantage resulting from the design of the frame.



Triple-Track Turret with 32 to 72 Tool Positions

The triple-track turret can accommodate up to 72 standard tools. When set up for the production program in use at any given moment, it is possible to execute most operations without extensive interruptions for tool-changing.



Number of tool positions in turret

Tool diameter (mm)	standard	option			special option		
[illegible]	–	–	–	–	–		
[illegible]	2	2	2	4	2	2	[illegible]
[illegible]	2	2	4	4	2	3	4
[illegible]	4	4	4	4	6	4	4
[illegible]	6	24	20	4	24	2	6
[illegible]	48	24	4	[illegible]	4	24	4
Total number of positions	72	56	48	32	52	46	44

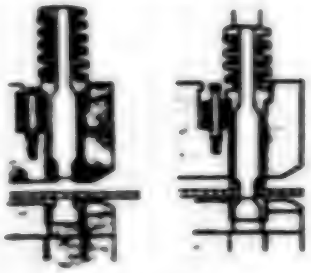
The turret can rotate in both directions so that the shortest, and thus the quickest, path from momentary tool position to work position can be selected.

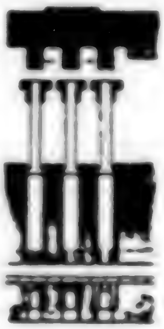
Tool and Tool Guide

The punch and die, exactly aligned, represent a single unit. This along with the long tool guides and in conjunction with the stable bridge frame construction (no deflection) results in unusually long service life for the tools.

The tools are manufactured from high-alloyed tool steel and can be resharpened without difficulty. The adjustment feature on the punch head makes it possible to maintain proper punch height after sharpening.

The punch guide fixes the blank in place before the actual punching operation is begun. After completion of the punch cycle, the tool is first retracted from the blank followed by the tool guide. This is particularly advantageous when punching thin sheeting at close intervals.



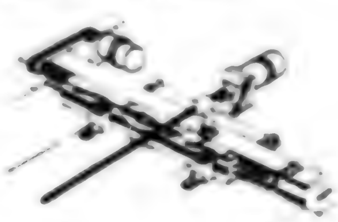


Tool Track Selection

The selection of the tool track is pre-programmed when punching the paper tape and thus is regulated automatically during operation. A double-action pneumatic cylinder positions the ram striker over the desired track. Safety switches keep the ram from striking unless it is correctly aligned.

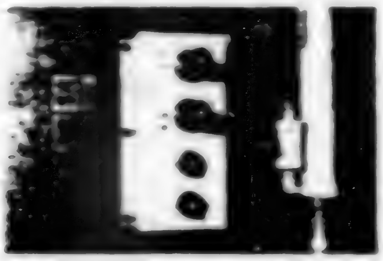
DC Servo Motors

The blank is positioned exactly for punching by means of DC servomotors which position the work table, which is suspended in two linear ball bearings. The entire table rests on tempered dovetail guides.

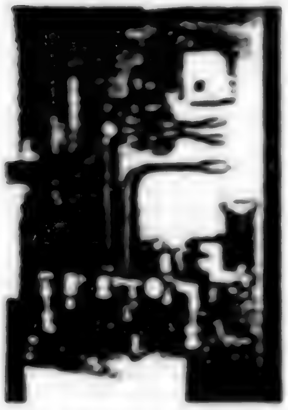


Tool Lift

To make it easier for the operator to change out the larger tools, a pneumatic lift is provided over the tool change point. A slow adjustment speed is provided to lower the tool gradually into the turret guides.

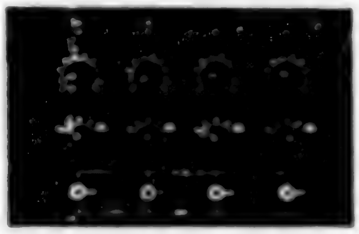


Defect Locating System and Automatic Centralized Lubrication



The number of strokes of the tool is tabulated by an adjustable counter. After the pre-set value has been reached, all critical parts such as crankshaft bearings, turret bearings, ram, etc., are automatically lubricated.

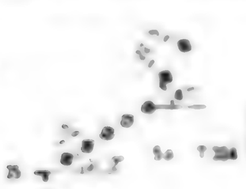
The economic effectiveness of an NC machine is based on its efficiency. In order to keep efficiency as high as possible, the models in Amada's COMA series are equipped with a defect diagnosis system. Each sub-system connected to the machine's cable harness can be checked individually.



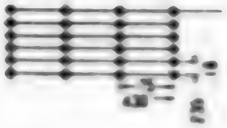
CNC Control

The COMA triple-turret punch presses utilize computer numerical control. CNC makes for far greater flexibility in comparison to "hard wired" NC systems; quick and simple re-programming are additional advantages of this design. The need for long, complicated programs is eliminated with CNC control. The computer executes all calculations and considers the track positioning of the ram striker.

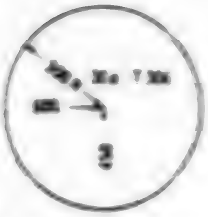
The following programming examples show how uncomplicated the basic programs are.



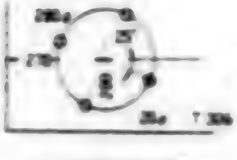
G 28 I 1500 J 3120 K 5 T 304
G 28 I 2250 J 4700 K 2



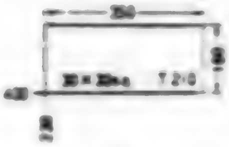
G 37 I7500 P 3 J1800 K 5



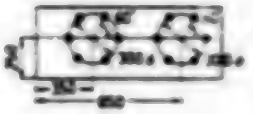
G 68 I30000 J9000 K 36000
P3000 Q 600 T306



G26 I 14000 J 6500 K4 T306



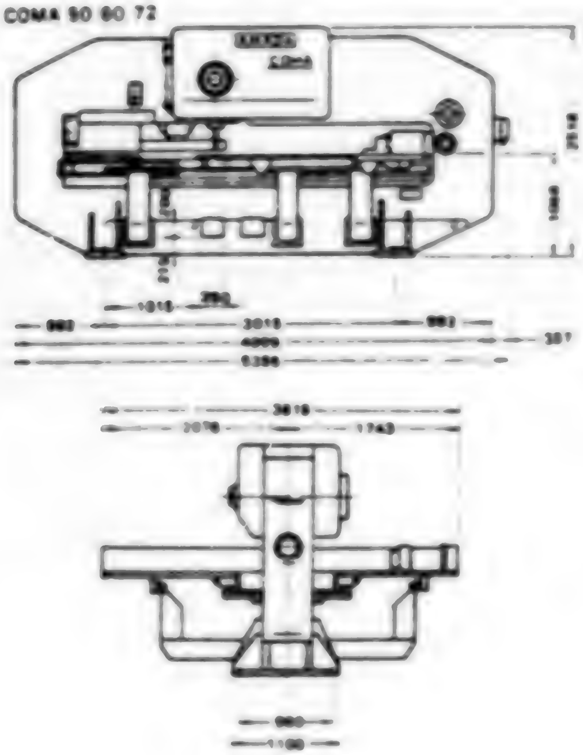
G 67 I 35000 J16000
P3000 T 210



A1G26 I 15000
J0 K6 T203 (10⌀)
G 72 X85000
B1

In addition to above basic programs, the multiple product punching function which increases the productivity of small products is available as a standard software.

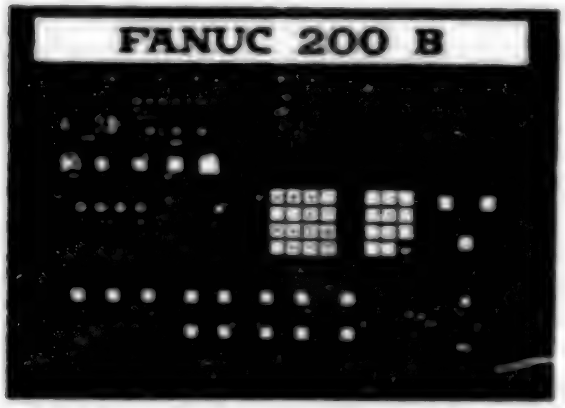
Technical Data for COMA Triple-Track Turret Punch Press



Specifications

	COMA-50-60-72	COMA-50-50-72	COMA-50-50-50
Capacity (ton)	50	50	50
Max. plate size (mm)	1,525 x 3,660	1,270 x 3,660	1,270 x 2,540
Max. plate thickness (mm)	6.35	6.35	6.35
Positioning accuracy (mm)	±0.15	±0.15	±0.15
Turret tool capacity	72	72	72
Table travel speed (m/min)	50	50	50
Hits per minute (on 25mm moves)	200	200	200
Turret speed (rpm)	30 (bi-directional)	30 (bi-directional)	30 (bi-directional)
Ram strokes per minute	300	300	300
Automatic repositioning	standard	standard	standard
Compressed air supply (kg/cm²)	5.7	5.7	5.7
Machine weight (ton)	16.5	14.5	14.0

CNC Specifications

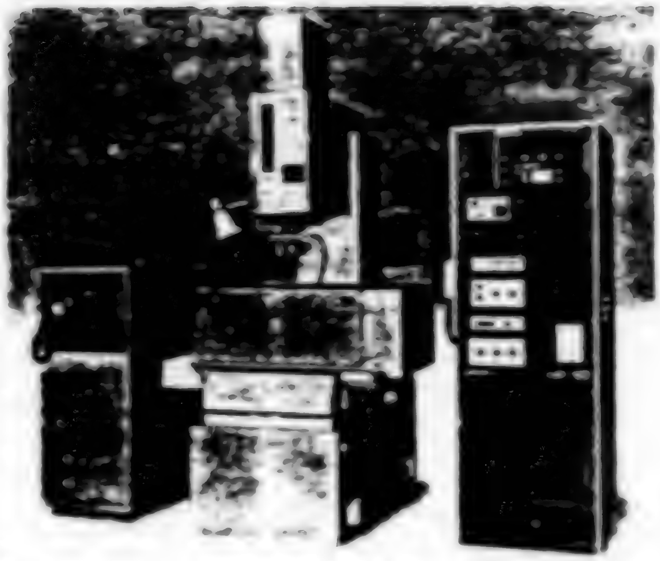


Model: Fanuc 200-OB
Memory capacity . . . . 16 kw (standard)
Dimensions . . . . .1000 mm long x 500 mm deep x 1760 mm high
1 set, control cabinet . . . 960 mm long x 500 mm deep x 1760 mm high

Number of simultaneously controlled axes . . . . 3 axes
Programming format . . . EIA or ISO code, standard, with 8-track paper tape
Programme mode. . Incremental and absolute, integrated
Smallest input increment . . . . .0.01 mm
Max. programmable dimension. . . . . .99,999.99 mm
Sequence number 3-digit
Paper tape code. . . . . EIA, ISO word address system
Punch functions . . . . .G 2 digit
Tool functions . . . . .T 3 digit
Auxiliary functions .M 2 digit
Manual input . . . . Direct at control console
Paper tape reader. . . . . Photoelectric, 200 characters/sec.
Zero-point return . . . . Manual with push-buttons or through programmed order
Block check . . . . With check bit on paper tape
Block skip . . . . Switched at control console
Warning signals . . . . Programme error, Excess temperature, Overtravel, Servo alarm, Sequence error

Model DP35B with JAPT-02P
Precision EDM Machine

JAPAX Inc.



3-Axis Digital Control with Latest Technologies and Concepts for High Performance NC Operation

The equipment also includes the JAPT-02P, an NC equipment rich in novel functions including playback function, realizing full automatic NC-EDM.

Main Features

- Playback function is the core of automation in machining setup and unattended operation.
- Side machining, enlarged machining, and taper machining made easy.
- The M function, commanding operations other than NC feed of the table, has realized full automatic operation with such functions as commanding ON-OFF of electrical discharge, calling of machining conditions, ON-OFF of dielectric fluid, etc.
- Automatic contact positioning function frees operators from exacting positioning work.
- Automatic origin return function.
- Equipped with MYSEL II program controlled EDM Data Analysis and Processing Unit.

The flow of operations is substantially changed by state-of-the-art NC equipment.

Effect of NC-EDM (JAPT-02P NC Unit)

Alignment electrode changing: Fast and accurate alignment made possible by the presetter. Automatic electrode changing by the AEC (optional).

Positioning: Automatic positioning by centering function and automatic edge finding function permit high accuracy 1μm step positioning. Return to reference point is also made easy by the origin return function.

Selection of machining conditions: The automatic reciprocation control, current density control, and presetting function of machining conditions by the MYSEL II permits programmed selection of machining parameters during continuous automatic operation. Maximum steps of selectable programs: 8 steps.

Axial control: Efficient side machining. Programmed path can be enlarged, contracted or tapered.

Modification of machining results (Effect of playback function): Easy measurement during/after machining. Correction of dimensions is easy using the playback function.

Electrode generation & modification: Electrode modification by reversed discharge. Small-diameter electrode can be generated with the spindle head (option) and the X-Y servo.

Programming: MDI and paper tape input. Playback input is without programming. Dwell input for each block. Continuous automatic operation of complex processes and multiple jobs. 120 hrs memory function for power shutdowns.

Specifications

(Unit: mm)

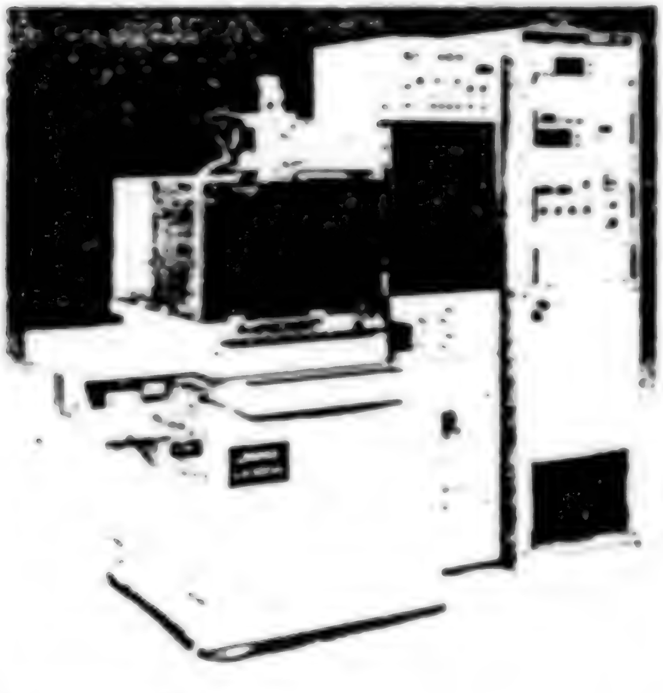
Model	DP10	DP20	DP35B	DP55	DP85
Work table (W x D)	350 x 240	420 x 260	600 x 350	700 x 500	1,000 x 700
Work tank (W x D x H)	500 x 340 x 200	550 x 360 x 200	800 x 500 x 300	1,200 x 750 x 500	1,900 x 1,050 x 700
Table traverse travel	200	250	300	800	1,300
Table longitudinal travel	100	150	200	400	600
Ram servo travel	(Servo) 80 (Manual) 150	(Digital servo) 200	(Digital servo) 250	(Digital servo) 250	(Digital servo) 450
Maximum electrode weight kg	10	15	75	150	500
Outside dimensions (W x D x H)	925 x 955 x 1,980	880 x 850 x 2,010	1,325 x 1,400 x 2,415	1,800 x 1,500 x 3,000	3,380 x 2,750 x 3,830
Net weight kg	600	700	1,400	4,500	9,500

Model LS350A
High Accuracy, Low Cost Wire-Cut EDM Machine

JAPAX Inc.

High stability, high performance mechanical characteristics assure high accuracy yet easy operation

The LS350A features high accuracy and high stability mechanical constructions built to permit easy operation. Highly systematized various functions, represented by such units as the Control Unit JAPT3E, in which high level functions are standardized, and the JAPT Auto Programming Unit JAPT2A.E, which offers software of new concept, have been evolved about LS350A Wire-Cut EDM Machine.



Pursuit of High Accuracy

- An Accurate NC Table

Precision roller guides and ball screws transport the workpiece positively. Rugged construction easily supports heavy loads. Large diameter ball screws and quality roller guides maintain constant accuracy over long operations. (Ball screws are supported at both ends to provide rigidity.)

- Drive System

Motor movement of 1μm (40 microinch) increment is detected to insure accurate and smooth machining.

- Lead Screw Pitch Error Compensation

Workpiece is measured at the actual setup position permitting correction of positional errors.

- Rigid Workpiece Table

Even when a heavy workpiece is loaded and clamped tightly, the rugged table exhibits no displacement. It accurately maintains the workpiece position over a long time span.

- Uniquely-shaped sapphire wire guides retain the wire laterally in all directions.

They are made of low friction material and are spaced to prevent any appreciable slack of the wire. These features permit large accurate taper angles to be readily machined. The guide mechanism permits easy operation and sufficient flushing without affecting the stable wire running.

Pursuit of Easy Operation

Digital Display

The X, Y table movement is displayed in the increment of 1μm. By means of a selector switch, block No. and table speed during machining are displayed, enabling an operator to know machining condition at a glance.

Pursuit of Stability

- **Continuous Stable Machining**

Japax's Clear-Cut unit, peerless in the world, does adaptive control according as gap condition, permitting high accuracy and many hours' stable, yet high speed continuous machining.

- Rigid Upper Arm

The upper guide moves vertically according as workpiece thickness. With high accuracy roller guide and spring balance mechanism, the guide moves smoothly and accurately for a long period of time.

Specifications

(Unit: mm)

Model	LS250A	LS350A	LS500A	LS800A	LS1000A
Maximum dimension of workpiece (W x D x H)	400 x 300 x 100	400 x 500 x 120	500 x 600 x 150	1,000 x 600 x 150	1,200 x 600 x 15
Maximum weight of workpiece, kg	100	200	300	600	800
Table traverse travel	150	250	300	500	500
Table longitudinal travel	250	350	500	800	1,000
Table displacement minimum unit	0.001	0.001	0.001	0.001	0.001
Outside dimensions (W x D x H)	1,070 x 960 x 1,660	1,365 x 1,110 x 1,676	1,625 x 1,530 x 1,745	2,305 x 2,060 x 1,650	2,305 x 2,660 x 1,67
Net weight, kg	800	1,300	1,800	4,200	4,800

Leading Manufacturer of Lathe Chucks

Kitagawa Iron Works Co., Ltd.

Since our company had been established by the present chairman, Mr. Jitsuo Kitagawa as a private company in 1918 and succeeded into the incorporation in 1941 as Kitagawa Iron Works Co., Ltd., we have made rapid progress broadly in three divisions of the machinery (construction and machine tools accessories), the iron casting (mechanite cast iron) and the housing (prefabricated houses and housing site preparation) over forty years. The sales amount for the 1981 fiscal year (Sep. 21, 1980 to Sep. 20, 1981) is going to exceed largely the estimate 27 thousand million yen.

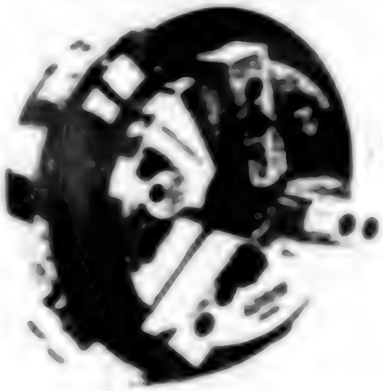
We have six plants, namely head office plant, Tokyo and Wakayama plants as a machinery plant, Shimokawabe and Nakasu plants as a cast iron plant and Kozan plant as a prefabricated house plant, and newly-built Motoyama plant will start in operation on September 1981 as a lathe chuck special plant for the exportation mainly. In each factory a lot of machining centers and industrial robots are now in work and under the high quality and the mass production, all about 1300 employees deliver the KITAGAWA-brand superior products toward all over the world market. In particular, our company proves the competitive price and the higher quality to be a leading maker of machine tools such as various lathe chucks including manual and power chucks, various NC-rotary tables including precision indexing heads, in addition pallet changers relating to a machining center, in the world market as well as in Japan.

On convenience of paper, we will explain as below with limit to the main products in relation to the exportation which gain popularity from the abroad.

The management and staff at Kitagawa are dedicated to contribution with Kitagawa own precision machine tool technics in this most expectable field for the enlargement of future business. Your sustained support and patronage will be welcomed.

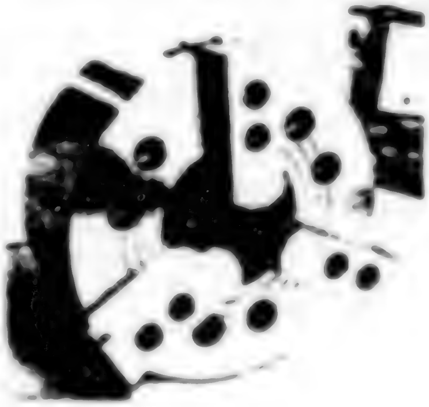
Air Operated Universal Front-end Chuck
Model UVE-K

UVE160K (6") to UVE800K (32") are made in series and moreover the large dia. thru-hole chuck, of which jaw stroke is no less than 1 inch, is manufactured with a large lot for machining threads of oil digging pipe. We are ready to response them as soon as you contact us if you have some inquiries about the lathe chucks.



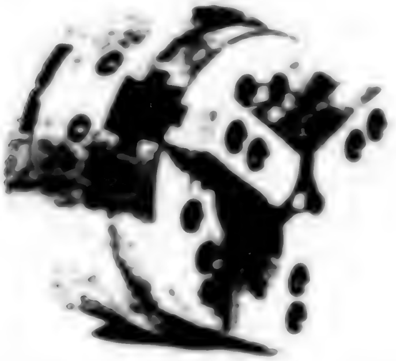
High Speed Thru-hole Power Chuck
Model HOB

Using the special alloy on all the chuck body and jaws, making an induction hardening on the body sliding face and grinding them completely, this chuck is designed and manufactured with the carefull attention to the accuracy maintenance and the durability. Moreover the stable maintenance of the high gripping force in high speed rotation is characterized remarkably.



Ultra High Speed Thru-hole Power Chuck
Model HOH

To keep the gripping force in the range of ultra high speed rotation, this chuck incorporates the counter balance weight, by which the reduction of the gripping force by centrifugal force can be compensated. On HOH-6 (6", center bore 33mm), the max. revolution can attain to 6700 rpm.



Ultra High Speed Thru-hole Hydraulic Cylinder
Model F

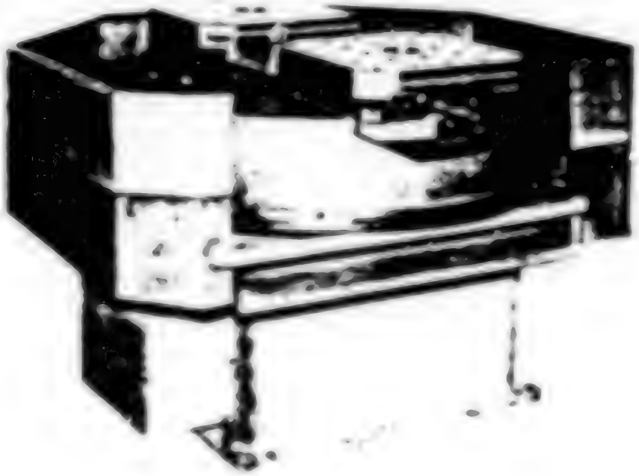
It is the F type ultra high speed cylinder which has been developed for HOB type high speed thru-hole chuck and HOH type ultra high speed thru-hole chuck. This cylinder has the self-coolant system by means of the incorporated fan and accordingly it is unnecessary to furnish the oil coolant device separately. This makes a remarkable fall in the investment cost possibly.

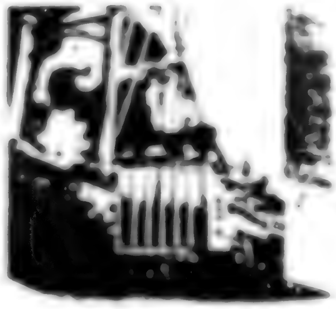
NC-rotary Table Model NRT
Control Unit for NC-rotary Table Model MAC

Over the wide range of the table dia. from 250mm to 1250mm. NC rotary table series are manufactured completely as a standard type. The spindle bearing gets the excellent high rigidity due to its special structure and the worm gear is of the highest class, adopted with large module, large dia. and double lead worm. Indexing accuracy is within ± 2 sec. Additionally the use of control unit of SUPER-MAC could perform the accuracy within ± 5 sec. due to its compensating mechanism. The control unit SUPER-MAC is the low cost and reliable single spindle NC equipment developed for the exclusive use of NC indexing table.

Pallet Changer and Pallet Magazine

Our company, as a machine tool maker concerning a machining center, is also designing and manufacturing various kinds of pallet changers and pallet magazines for the vertical as well as the horizontal machining besides NC rotary table.





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CURRENT TRENDS OF MACHINERY INDUSTRY

Tokyo DIGEST OF JAPANESE INDUSTRY AND TECHNOLOGY in English No 164, 1981 pp 82-88

[Article by Shigenari Tsuruoka, Economic Research Institute, Japan Society for the Promotion of Machine Industry]

[Text]

Current Status of Japanese Machinery Industry; International Comparison

Comparing the statistics of Major Nations, current status of Japanese machinery industry will be presented in my lecture. Oil crisis in 1973 hit the world to slow down the economic growth of leading nations, including Japan, as the Table 1 shows. It is, however, pointed out that Japanese economic growth in average for the 1973-79 period marked the highest among those leading nations. This fact contributed to the consolidation of the Japanese machinery industry. It is the period when even Japanese businessmen were fully conscious of comparative strength of the Japanese machinery industry. Generally it is said that the Japanese machinery industry is competitive in the international market. And the value of the Japan's machinery export amounted to as much as 61 percent of her total export value in 1979 (see the Table 4). The transportation and electric machinery are major sectors for the export market.

Japan's industrial structure is in the process of further changing. In 1975 the portion of the machinery industry in the Japanese manufacturing industry was 28 percent and it is estimated that in 1985 the machinery industry will account for 32.9 percent in the Japanese manufacturing industry. This could cause another trade friction, if a substantial portion of such an expanded production is to be exported.

In 1970s Japan has been experiencing the remarkable increase in its market share, while the respective market shares of West Germany and the U.S.A. have been declining. With reference to composition of machinery exports by type of production, Japan exports automobiles, ships, radio and TV sets, in the order of percentages of total export amounts.

Concerning the machinery import, Japan imports only little. According to the order of import amount, the first is electric machines such as semi-conductors and electronic parts. Also it imports other general machinery, and business machines including large-size computers.

Table 1. Economic Growth Rate in Major Nations

(Unit: %)

	Japan	U.S.A.	F.R.G.	U.K.	France	Italy
1973	10.0	5.5	4.9	8.0	5.4	7.0
1974	- 0.5	- 1.4	0.4	- 1.9	2.8	4.1
1975	1.4	- 1.3	- 1.8	- 0.7	0.3	- 3.6
1976	6.5	5.9	5.3	3.6	4.9	5.9
1977	5.4	5.3	2.6	0.9	2.9	1.9
1978	6.0	4.4	3.5	2.4	3.3	2.6
1979	5.9	2.3	4.4	0.3	3.2	5.0
1973-79 (average)	4.0	2.5	2.3	0.9	2.9	2.6

Remarks: Japan: new SNA; U.S.A. and F.R.G.: GNP; U.K. and Italy: GDP; France: GDP based upon SNA.

Table 2. Machinery Industry in National Economy (1978)

	Japan GDP		U.S.A. GNP		F.R.G. GDP	
	1,000 million US$	%	1,000 million US$	%	1,000 million US$	%
Gross product	1,053	100.0	2,108	100.0	700	100.0
Primary industry	50	4.8	64	3.1	19	2.6
Secondary industry	595	37.5	664	31.5	289	41.3
Manufacturing industry	305	29.0	510	24.2	261	37.2
Machinery industry	105	9.9	171	8.1	102	14.5
Tertiary industry	608	57.7	1,379	65.4	392	56.1
	1 US$ = ¥194.60				1 US$ = 1.828 D.M.	

Remarks: (1) Primary industry: Agriculture, Forestry and Fishery
Secondary industry: Mining, Manufacturing and Construction
Tertiary industry: Industries other than the above
(2) Some of the numbers for U.S.A. and F.R.G. are estimates.

Growth of Post-War Japanese Economy and Machinery Industry

Japanese economy has experienced many changes after the Second World War. According to the characteristic of its structural changes, the periods will be able to be devided as follows;

1945-55: This decade was for the reconstruction

Table 3. Shipments of Machinery Industry (1977)

	Japan		U.S.A.		F.R.G.	
	Million US$	%	Million US$	%	Million US$	%
Total	183,508	100.0	404,076	100.0	142,994	100.0
General machinery	47,397	25.8	119,008	29.4	46,846	32.8
Electric machinery	56,147	30.6	85,759	21.2	39,885	27.9
Transportation machinery	71,056	38.7	170,739	42.3	50,622	35.4
Precision machinery	8,908	4.9	28.570	7.1	5,641	3.9
	1 US$ = ¥240.00				1 US$ = 2.1050 D.M.	

Remark : For F.R.G., the shipments of corporations with 20 employees or more were revised to indicate the total shipments of all the corporations on the basis of the number of employees.

of the Japanese economy to become independent. For this, the priority was given to the energy industry and the basic material industry, such as for coal, steel, fertilizers, cement and power generation. The only thing exported during this decade was textile.

1955-65: In 1956 the Japanese ship-building industry exceeded the U.K. counterpart by their production and became the biggest in the world.

In the first half of this decade, precision machinery such as cameras and watches, and household appliances such as TV sets, electric washing machine and refrigerator were extensively developed. They were replaced by automobiles and machine tools in the second half.

In this decade the Japanese economy experienced the high growth, being supported by the then-arising technological innovation. Also, the population enjoyed the large spread of consumer durable goods. And transistor radios, tape recorders, ships were exported.

1965-73: This period was characterized by the 2nd High Growth Economic period of Japan. Until oil crisis occurred Japanese economy had enjoyed the very rapid economic growth. The automotive, housing, leisure, pollution-presentation, fashion industries became steadily the major industries. Mainly exported were automobiles, office equipments and sophisticated electronics.

1973- : After the oil crisis the Japanese economy entered upon the low-growth period endeavouring to adjust it to new worldly circumstances. In this period plant engineering became rapidly the major industry with a considerable plant export.

Underlying Reason for the Strength of the Japanese Machinery Industry

Why is the Japanese machinery industry strong? This is the very question posed frequently. But it is not so easy to answer this question. Generally it is said that the Japanese machinery industry succeeded in adapting good technology, realizing high labor productivity and introducing electronics. No doubt, these elements contributed and are contributing to the strength of the Japanese machinery industry. But it is difficult to recognize how much the respective element does contribute to it.

Good technology may be divided into two aspects: design technology, production technology. Two combine to upgrade quality and function of products while they also realize the lower price. Especially after 1973, the new worldly economic condition enforced the Japanese industry to raise labor productivity. The number of female workers spontaneously leaving the company has not been replenished, otherwise industrial robots in large quantity have been introduced, which have been contributing to the higher labor productivity. To date, 75,000 robots, which is 80 percent of the number of industrial robots in the world, are operating in Japan. And it is estimated that the number will increase drastically in the coming decade.

Table 5. Long-term Prospects of Industrial Structure – Machinery Industry in Manufacturing Industry

(Unit: billion yen)

	1970	1974	1975	1985
A Manufacturing industry	125.4	155.5	143.0	268.3
B Machinery industry	32.3	44.4	40.0	88.3
B / A (%)	25.8	28.6	28.0	32.9

Introduction of electronics into machinery industry is characteristic of the Japanese machin-

Table 4. Exports of Machinery

(1979)

	Japan		U.S.A.		F.R.G.	
	Million US$	%	Million US$	%	Million US$	%
Total export value	102,801		181,802		159,398	
Total machinery export	62,704	(61.0) 100.0	84,779	(44.6) 100.0	80,783	(50.7) 100.0
General machinery	13,850	22.1	44,741	52.8	30,506	37.8
Electric machinery	16,361	26.1	8,635	10.2	16,908	20.9
Transportation machinery	26,775	42.7	25,750	30.4	29,889	37.0
Precision machinery	5,718	9.1	5,653	6.6	3,480	4.3
	1 US$ = ¥240.00				1 US$ = 1.8329 D.M.	

Remark : Figures in parentheses are the ratios of machinery export against total export.

Table 6. Market Shares of Major Machinery Exporting Countries

(Unit: million US$)

	1965	1970	1973	1975	1976	1977
OECD	41.323	82.185	148.499	221.712	251.015	286.852
F.R.G.	25.4	20.4	22.3	19.8	20.3	20.7
U.S.A.	21.2	22.8	19.6	21.5	20.6	18.6
Japan	7.0	10.3	13.1	13.2	15.3	16.8
France	6.7	7.4	8.0	8.9	8.6	8.6
U.K.	14.0	10.1	8.3	8.6	7.6	7.9

Table 7. Composition of Machinery Exports by Type of Product

1977 (Unit: million US$, %)

	%*	No. 1	No. 2	No. 3	No. 4	No. 5
Japan	60.0	automobiles 14,653 (30.4)	ships 8,129 (16.8)	radio receivers & TV sets 5,892 (12.2)	other machines 4,282 (8.9)	optical equipment & measuring instruments 2,643 (5.3)
U.S.A.	45.3	automobiles 11,797 (22.1)	other machines 8,384 (15.7)	aircrafts 5,866 (11.0)	other electric machines 4,593 (8.6)	business machines 3,645 (6.8)
F.R.G.	50.3	automobiles 16,568 (28.0)	other machines 11,694 (19.7)	other electric machines 3,823 (6.4)	special industrial machines 3,316 (5.6)	prime movers 3,107 (5.2)
France	50.3	automobiles 7,728 (31.4)	other machines 4,029 (16.3)	other electric machines 1,573 (6.4)	heavy electric machinery 1,380 (5.6)	prime movers 1,336 (5.4)
U.K.		automobiles 4,667 (20.7)	other machines 3,517 (15.6)	prime movers 2,203 (9.8)	special industrial machines 1,844 (8.2)	other electric machines 1,471 (6.5)

*Percentage of machinery export against total export.

Table 8. Composition of Machinery Imports by Type of Product of Major Machinery Importing Country

1977 (Unit: million US$, %)

	%*	No. 1	No. 2	No. 3	No. 4	No. 5
Japan	6.8	other electric machines 738 (15.3)	other machines 735 (15.2)	business machines 603 (12.5)	optical equipments & measuring instruments 411 (8.5)	prime movers 406 (8.4)
U.S.A.	26.1	automobiles 17,529 (45.5)	radio receivers & TV sets 3,749 (9.7)	other electric machines 2,798 (7.3)	other machines 2,667 (6.9)	prime movers 2,247 (5.8)
F.R.G.	20.8	automobiles 5,019 (24.4)	other machines 2,847 (13.6)	other electric machines 2,204 (10.5)	business machines 1,531 (7.3)	radio receivers & TV sets 1,297 (6.2)
France		automobiles 3,847 (22.5)	other machines 2,953 (17.3)	other electric machines 1,559 (9.1)	business machines 1,188 (7.0)	prime movers 1,086 (6.4)
U.K.		automobiles 3,636 (23.4)	other machines 2,142 (13.8)	business machines 1,428 (9.2)	special industrial machines 1,406 (9.0)	other electric machines 1,337 (8.6)

*Percentage of machinery import against total import.

Growth of Post-War Japanese Economy and Machinery Industry

	1945 1950	1955 1960	1965 1970	Oil crisis 1975 1980
General economic condition	preparatory period for economic recovery and independence	high-growth period with the beginning of technological innovation	end of high-growth	adjustment period low-growth period
Consumption trend	sufficiency in food and clothing	spread of consumer durable goods	leisure, housing, fashion	social consumption and demand
Major industries	coal steel fertilizers electric power coal steel cotton spinning *shipbuilding cement	*household electric appliance chemical industry electric power (thermal) synthetic fiber *precision machinery petroleum industry *electronics industry *general machinery	automobile housing industry leisure industry pollution preventive industry fashion industry	systems industry information industry plant engineering
Industrial foundation	basic material and energy industries	technological innovation industry assembly industry	information and system industry, energy-conservation and energy industry plant	
Major export commodity	textile products	*shipbuilding steel * camera *sewing machine *transistor radio *TV sets *tape-recorder synthetic fiber	* automobile *office equipments * electronics	automobile bearing plant
Characteristic of labor	labor-intensive	technology and labor-intensive	technology and knowledge-intensive	

Remark: * indicates the machinery industry ery industry. It has contributed to upgrading products. For instance, as much as 20 percent of production cost of the automotive industry is spent for electronics. Other examples include calculators, sewing machines, scales, cash registers, automatic vendors, copying machines, agricultural and medical equipments.

Future Prospect

What about the Japanese machinery industry in the near future? With the reference to this question rather optimistic forecasts are prevailing, which are founding on the last steady progress and relative strength of the Japanese machinery industry. The Japanese machinery will remain in the favorable position it enjoys now, provided that no new machine will be launched in the international market in 1980s.

There appears a tendency for the world's machinery industry to go through the re-structuring, including the automotive industry. Through such a process, major companies of the Japanese machinery industry will play the leading role. ■

Table 9. Number of Female Workers in Electronics & Electrical Manufacturers

	1972	1973	1974	1975	1976
Hitachi	9,051 (10.8)	7,537 (9.3)	6,096 (8.6)	4,681 (6.3)	4,233 (5.8)
TOSHIBA	12,655 (18.0)	11,991 (17.0)	11,071 (15.5)	8,481 (12.5)	7,236 (11.0)
Matsushita	9,825 (21.7)	9,090 (19.6)	8,120 (17.3)	6,637 (14.8)	5,300 (14.5)
SONY	4,498 (43.5)	4,376 (39.9)	3,534 (34.9)	3,004 (31.0)	2,778 (29.3)
NEC	4,724 (13.8)	3,949 (11.9)	3,164 (9.6)	2,278 (6.9)	1,916 (6.0)
FUJITSU	5,940 (21.9)	6,446 (21.6)	6,372 (20.4)	5,630 (18.0)	5,160 ([illegible])
TDK	1,143 (24.9)	1,012 (22.0)	967 (19.4)	415 (9.7)	328 (7.8)
Total	47,836 (17.4)	44,401 (16.1)	39,384 (14.4)	31,126 (11.8)	27,677 (10.7)

Remarks 1. Figures in parentheses are the percentage of women workers against total employees.

2. The numbers for Toshiba, Matsushita, Fujitsu include a part of clerical women workers. The numbers of 1976 for Matsushita and Fujitsu are estimates.

Source: Japan Economic Journal, Nov. 25, 1976

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Dec. 31, 1981